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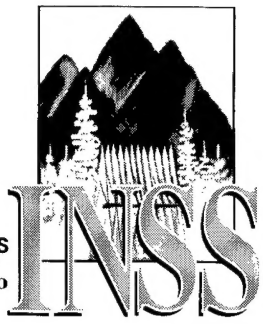
Proliferation Series

Five Minutes Past Midnight:

The Clear and Present Danger of Nuclear Weapons Grade Fissile Materials

Guy B. Roberts
February 1996



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14. ABSTRACT

Growing stockpiles of nuclear weapons grade fissile materials (plutonium and highly enriched uranium) are a "clear and present danger" to international security. Much of this material is uncontrolled and unsecured in the former Soviet Union (FSU). Access to these materials is the primary technical barrier to a nuclear weapons capability since the technology know-how for a bomb making is available in the world scientific community. Strategies to convince proliferators to give up their nuclear ambitions are problematic since those ambitions are a party of largest regional security.

There is no national material control and accounting in Russia. No one knows exactly how much fissile materials they have, and if any is missing. A bankrupt atomic energy industry, unpaid employees and little or no security has created a climate in which more and more fissile materials will likely be sold in black markets or diverted to clandestine nuclear weapons programs or transnational terrorist groups. Control over these materials will ultimately rely on the continuous and simultaneous exercise of several measures. While there is little one can do now to stop a determined proliferator, over time international consensus and a strengthened non-proliferation regime will convince proliferators that the costs outweigh the gains.

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FIVE MINUTES PAST MIDNIGHT: THE CLEAR AND PRESENT DANGER OF NUCLEAR WEAPONS GRADE FISSILE MATERIALS

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TABLE OF CONTENTS

FOREWORD

We are pleased to publish this eighth volume in the *Occasional Paper* series of the US Air Force Institute for National Security Studies (INSS). This monograph represents the results of research conducted under the auspices of an INSS grant during fiscal year 1995.

The paper focuses on the most intractable and pressing problem of nuclear weapons proliferation: the spread of nuclear weapons-usable fissile materials. It reviews recent initiatives and proposals to stop or slow that spread, and to impede the acquisition efforts of those that seek to acquire them. This is only part--albeit the most crucial--of the nuclear weapons proliferation problems.

There have been voluminous proposals regarding how the international community can strengthen non-proliferation norms, ranging up to and including the absolute ban on the possession of nuclear weapons--an approach Roberts judges to be impractical for the near term. He suggests several initiatives, however, that have the best chance for further enhancing the non-proliferation regime in the context of controlling and eventually stopping the spread of nuclear weapons-usable fissile materials. These initiatives may make the utility of such weapons as a coercive force less credible.

There are those who believe the effort is not worth it, that the continuing spread of fissile materials is inevitable. They are wrong, says the author. Tough "supply-side" controls can close the spigot to a slow drip while time and commonality of interests in non-proliferation change the political motivation to acquire nuclear weapons. Eventually a seamless web of measures will result in the international community as a whole exercising the political will to stop and ultimately end the threat of a fissile material catastrophe.

INSS is co-sponsored by the National Security Negotiations Division, Plans and Operations Directorate, Headquarters US Air Force (USAF/XOXI) and the Dean of the Faculty, US Air Force Academy. The primary purpose of the Institute is to promote research done within the DOD community in the fields of arms control, proliferation, national security, regional studies, the revolution in military affairs, information warfare, and environmental security. INSS coordinates and focuses outside thinking in various disciplines and across services to develop new ideas for USAF and DOD policy making. The Institute develops topics, selects researchers from within the military academic community, and administers sponsored research. We also host conferences and workshops which facilitate the dissemination of information to a wide range of private and government organizations. INSS is in its fourth year of providing valuable, cost-effective research to meet the needs of the Air Staff and our other sponsors.

We appreciate your interest in INSS and its research products.

JEFFREY A. LARSEN, Lt Colonel, USAF
Director, Institute for National Security Studies

EXECUTIVE SUMMARY

While weapons of mass destruction have been recognized as a "major threat to our security," with nuclear weapons being the most potentially devastating, it is less understood that growing stockpiles of nuclear weapons grade fissile materials (plutonium and highly enriched uranium) are also a "clear and present danger" to international security. Much of this material is uncontrolled and unsecured in the former Soviet Union (FSU).

Fissile materials are the essential elements for nuclear bomb making. Access to these materials is the primary technical barrier to a nuclear weapons capability since the technological know-how for bomb making is available in the world scientific community. A determined proliferator will be capable of making a nuclear weapon irrespective of financial and political costs, as has been demonstrated in South Africa, Iraq, and North Korea. Strategies to convince proliferators to give up their nuclear ambitions are problematic since, for the most part, those ambitions are a part of larger regional security concerns.

The proliferation risks of fissile materials are great and there are no short term solutions. Of immediate concern is the breakdown of societal controls in the FSU and the huge amount of unsecured and uncontrolled fissile materials. *There is no national material control and accounting in Russia. No one knows exactly how much fissile materials they have, and at most sites not only do they not know how much they have, they do not know if any is missing.* A bankrupt atomic energy industry, unpaid employees and little or no security has created a climate in which more and more fissile materials will likely be sold in black markets or diverted to clandestine nuclear weapons programs or transnational terrorist groups.

Growing stockpiles of plutonium are another major proliferation risk. Plutonium is not an economically viable fuel and there are no good long-term solutions for its disposition. Plutonium is a by-product of nuclear reactors and it is expected that there will be enough for 70,000 Hiroshima-type bombs by the year 2010. Coupled with the inability of the International Atomic Energy Agency (IAEA) to adequately safeguard these materials, these growing stockpiles of plutonium are a serious long-term threat.

Despite the seemingly hopeless magnitude of the problem, a number of non-proliferation efforts have been taken to strengthen the international non-proliferation regime. The crown jewel of that regime is the Nuclear Non-Proliferation Treaty (NPT). Measures to build on the NPT have included nuclear weapon states agreeing to provide strengthened security assurances, establishing regional nuclear weapon free zones that include banning the production and reprocessing of fissile materials, harmonizing and expanding export controls, and negotiations on a fissile material cut-off regime that would cap existing stocks of fissile materials. Other initiatives include enhanced cooperation with law enforcement officials to stop nuclear materials trafficking, the negotiation of a treaty making nuclear smuggling a crime against international law, endorsing IAEA proposals for strengthening safeguards, expanding material control and accounting efforts in the FSU, and funding for interim plutonium disposal options to lessen the risk of illicit diversion.

While unprecedented progress has been made, and the proposals for strengthening the non-proliferation regime contained here will hopefully be implemented, the problems of the FSU are too diverse and complex to be solved overnight. Nor can anything be done about the continued growth of plutonium in the short term. Control over these materials will ultimately rely on the continuous and simultaneous exercise of several measures -- ranging from building international regimes, regional conflict resolution, and cooperative efforts to slow and eventually reverse the availability of these materials. While there may be little one can do now to stop a determined proliferator, over time international consensus and a strengthened non-proliferation regime will convince proliferators that the costs far outweigh the gains.

The US will have to take the lead--because no one else can--to meet this challenge through the entire range of political and economic tools discussed. The regime is not foolproof, but that does not mean that the ongoing efforts and the proposals for enhancements are in vain. These efforts can close the proliferation spigot to a slow drip while time and the commonality of interest in non-proliferation change the political motivations to obtain these materials for illicit purposes. Eventually, a seamless web of measures will result in the international community as a whole exercising the political will to stop and ultimately end the threat of nuclear weapons.

FIVE MINUTES PAST MIDNIGHT: THE CLEAR AND PRESENT DANGER OF NUCLEAR WEAPONS GRADE FISSILE MATERIALS

> The breakup of the Soviet Union left nuclear material scattered throughout the Newly Independent States and increased the potential for the theft of those materials, and for organized criminals to enter the nuclear smuggling business. As horrible as the tragedies in Oklahoma City and the World Trade Center were, imagine the destruction that could have resulted had there been a small-scale nuclear device exploded there.
>
> - President William Clinton
> U.S. Air Force Academy, May 31, 1995[1]

I. What Is the Problem?

A recent public opinion survey revealed that the American people believe the danger from nuclear weapons is even greater today than during the Cold War.[2] Indeed, proliferation of weapons of mass destruction[3] may be the most important threat to US national and international security in the post-Cold War era.[4] The proliferation of nuclear weapons, as well as other weapons of mass destruction, will likely continue over the next few decades in a limited number of countries, posing a real and immediate threat to US interests, friends and allies, and forces deployed around the globe. Nuclear weapons proliferation is clearly the most threatening and devastating of these mass destruction weapons. Given the number of nuclear weapons in various world inventories and the relative availability of both technology and nuclear materials, the acquisition or fabrication of a nuclear weapon by a state or terrorist group with interests inimical to that of the US is alarmingly possible. And, given the already-prevalent availability of technology and information associated with building nuclear weapons, the greatest

threat and challenge to the nuclear non-proliferation regime in the immediate future will be to control and limit the spread of nuclear weapons-usable fissile materials. The danger is so great and the threat so immediate that US policy-makers and the public need to recognize the illicit diversion of fissile materials as a critical and urgent national security priority, one that will require top-level attention, public education and sufficient resource allocation if we are to eventually prevail over this new security challenge.

Weapon-usable fissionable materials are principally highly enriched uranium (HEU) and plutonium.[5] The explosive power of nuclear weapons derives from either of these fissile materials.[6] And, as a recent US National Academy of Sciences report warned, excess fissile material inadequately controlled or accounted for poses "a clear and present danger" to international security.[7]

A. Why is Controlling Fissile Materials So Important?

Fissile materials comprise the *sine qua non* of nuclear weapons making. Limits on access to fissile materials are the primary technical barrier to acquisition of nuclear weapons capability in the world today. But once these materials are acquired, construction of nuclear weapons should be assumed to be relatively straight-forward for sophisticated terrorists or proliferant states. Even relatively unsophisticated terrorist groups could make a crude but workable nuclear bomb in the 10-100 kiloton range.[8] At least one "terrorist" group has openly sought to acquire this capability.[9]

One highly acclaimed physicist involved in the Manhattan Project noted that "with modern weapons-grade uranium, the background neutron rate is so low that terrorists, if they had such material, would have a good chance of setting off a high-yield explosion simply by dropping one half of the material onto the other half. Most people seem unaware that if separated U-235 is at hand it's a trivial job to set off a nuclear explosion. . . [E]ven a high school kid could make a bomb in

short order."[10] In any event, terrorists do not need the power or precision of a high-yield weapon. It has been reported that the United States conducted a successful nuclear blast using reactor-grade plutonium rather than weapons grade.[11] A low-yield dirty device made from reactor-grade plutonium in a truck could easily serve a terrorist's purposes, demolishing a small city and spreading radioactive fall-out far and wide. In a recent news account, for example, it was reported that Iraq, in addition to developing a nuclear bomb, worked on a "radiological" weapon, one that scatters deadly radioactive material without a nuclear explosion.[12]

Admittedly, nuclear weapon development is costly and time-consuming. But first-generation proliferators, using techniques and technologies available in unclassified literature and university classrooms, coupled with sufficient management and organizational skills and ample financial resources, would ultimately be successful in making nuclear weapons.[13] Present day proliferators, relying on "primitive" but proven technologies, with access to sufficient quantities of fissile materials, will be able to take shortcuts not available to US nuclear physicists who designed the first bombs during the Manhattan Project (1942-45).[14] Those first bombs weighed thousands of pounds. Today's proliferators, using desk top computers will be able to develop much smaller munitions using smaller amounts of fissionable materials that could soon be deliverable by ballistic missiles.[15] For example, Iraq, using processes developed during World War II, was able to separate isotope U-235 from a "civilian" reactor and enrich it to weapons-grade HEU.[16]

B. Scope and Purpose

The wide-spread prevalence of fissile materials, coupled with severe security and accountability problems resulting from the break-up of the former Soviet Union (FSU) and the continuing desire of some states to acquire a nuclear

weapons capability, present different problems and varying degrees of risk to international peace and security. These problems and attendant risks are the focus here. The multi-faceted problem of fissile material proliferation will be investigated in inter-connected parts.

First and foremost are the difficulties arising from the dissolution of the Soviet Union. A significant aspect of this problem is the trafficking in nuclear materials acquired from the FSU, and the concomitant lack of adequate controls and accounting of fissile materials. Second, is the growing stockpiles of plutonium resulting from both the dismantlement of nuclear weapons and the production of plutonium from reprocessed civilian reactor fuel. Third, the inadequacies of safeguards over nuclear technologies and materials have created unacceptable proliferation risks that will need to be addressed. Finally, strategies will have to be developed to address both those states not members of the NPT with unsafeguarded nuclear facilities and those with clandestine nuclear weapons programs.

This paper is focused on the most intractable and pressing problem of nuclear weapons proliferation; the spread of nuclear weapons-usable fissile materials and initiatives and proposals to stop or slow that spread and impede the acquisition efforts of those that seek to acquire them. It is understood that this is only part--albeit the most crucial--of the nuclear weapons proliferation problem. Although related, the problem of a "rogue" state acquiring an actual nuclear weapon through purchase or theft is not addressed. Nor are enforcement and counter-proliferation efforts discussed. Efforts to address enforcing non-proliferation norms are complex, beyond the scope of our work here, and have, in any event, been exhaustively examined by a number of authoritative sources.[17]

II. The Growing Proliferation Risks of Fissile Materials

A. Fissile Materials in the former Soviet Union (FSU) and the Breakdown of Societal Norms

> Potatoes [are] guarded better than radioactive materials...
> - Russian Special Investigator[18]

The divisive political and deteriorating economic conditions in the Russian Federation and the newly independent states (NIS) of the FSU have created a dangerous recipe for the diversion of nuclear weapons materials and technology to clandestine nuclear weapons programs.[19] The heightened potential for bankruptcy, instability, revolution or dissolution poses a deadly serious proliferation risk.[20] While beyond the scope of this paper, the residual chaotic situation in the FSU has made problematic responsible state control over not only nuclear materials and the facilities used to produce them but also the expertise, information, and technology used in the manufacture of nuclear weapons. The Director of the FBI, Louis Freeh, has called nuclear smuggling "the greatest long-term threat to the security of the United States."[21] In 1990, political extremists attempted to take over a tactical nuclear weapons storage site near the capital of Azerbaijan.[22] Continuing ethnic clashes in the Russian Federation, exploding into civil war, have occurred in Chechyna and North Ossetia as well as in the newly independent states of the FSU and will add significantly to the problem of controlling the illicit theft and diversion of fissile materials.

In Russia, growing criminal activity, blatant and pervasive corruption, and non-complying industries add to the proliferation concerns. For example, in 1992, 4,000 verdicts of corruption were brought against Russian military officers, and the Russian defense ministry reported 4,000 cases of theft of conventional

weapons, including tanks and aircraft, from military facilities in 1992 and nearly 6,500 cases in 1993.[23] Although there has been no documented cases of organized crime involvement in nuclear materials trafficking, given the current climate of wide-scale crime where even Russian President Yeltsin called organized crime Russia's number one problem,[24] it is quite likely that if they are not now involved they soon will be.[25]

Given the deteriorating economic situation in the FSU, terrorist groups or their state sponsors will likely have access to top-notch nuclear weapon designers, if the price is right.[26] Media reports have tended to confirm that scientists working in nuclear weapons programs have been seeking and have been offered employment with potential proliferant states.[27] Scientists and engineers working on nuclear weapons programs, once the elite of Soviet society, have steadily seen their privileges erode. As a result of the loss of incentives, decline in prestige, and the lack of funds for simple living expenses, let alone research, nuclear weapons specialists began to leave the FSU in search of employment opportunities in other countries. One report noted that in 1992 alone 9,200 Russian scientists found employment abroad.[28]

While efforts at improving their lot have begun, the situation has deteriorated even further over the last two years. For example, as recently as March 1995, a US source with established and regular contacts with the nuclear research institute Arzamas-16 (Kremlev) and Chelyabinsk-70 (Snezhinsk) reported that scientists at those institutes had not been paid since December 1994 and that those scientists had sent a joint appeal to MINATOM [Ministry of Atomic Energy] Minister Mikhailov for economic relief. Due to a similar situation two years ago, Arzamas-16 scientists took to the streets staging protests and threatening strikes--activities previously unheard of in closed cities.[29] It is the scientists, technicians and managers, in addition to security personnel, that are

best placed to take fissile materials with them when they leave for work at hard-currency-paying nuclear programs in states of proliferation concern.

1. The Lack of Adequate Materials Control

If nuclear facility scientists, engineers and other workers have a motive for nuclear trafficking they also have the opportunity. Security is more tenuous at most Russian nuclear facilities than at many ordinary office buildings in the US. The chairman of the National Academy of Sciences panel that studied the problem of plutonium disposition[30] observed first hand the continuing deterioration of basic custodial and control arrangements over fissile materials, commenting that "Any day now we could wake up and read the morning newspaper that enough material for a dozen bombs really has been stolen...."[31] A science advisor to President Yeltsin, Valery Menschikov, said that "Fissile materials have become a big commodity on the world market because we have not had the discipline or the money to create a system for protecting them."[32] Menschikov found one facility at the Tomsk complex in Siberia holding nuclear weapon cores protected by a single lock and one guard.[33]

Anecdotal and ominous reports abound about the lax security and the opportunity for theft. Given the economic, social and political instability in the FSU, coupled with an erosion of moral standards, human reliability in physical protection of these materials has eroded substantially. As a consequence, "the primary threat to nuclear safeguards in Russia today is a knowledgeable and corrupt insider (or group of insiders) who have access to nuclear materials and may attempt to steal them for profit, for political reasons, or because they are coerced by a criminal organization."[34] One frustrated US official told how on a recent visit to a nuclear facility in Russia he noticed new motion detectors in one part of the facility. Later, when he inquired about them he was told the detectors

were put in just for the US visit. They had not been permanently installed for fear that someone would steal them.[35]

The facts about the magnitude of this problem are sobering: there is no national fissile material control and accounting in Russia. No one knows exactly how much plutonium or HEU they have, and at most sites not only do they not know how much they have, noe do they know if any plutonium or HEU are missing.[36]

The deputy chairman of the nuclear oversight agency Gosatomnadzor (GAN), Yuri Zubkov, said that "Russia is facing a critical problem of establishing strict control and accounting for nuclear materials. We are just at the beginning."[37] GAN is ostensibly the inspectorate responsible for ensuring that sensitive nuclear materials are safeguarded in Russia, including military nuclear stockpiles. But the military has refused to cooperate, and GAN has been involved in a often bitter bureaucratic battle with MINATOM over tightening regulatory controls over Russia's nuclear archipelago.[38] "It's impossible at this point to take everything under control," Zubkov, conceded in an interview.[39] Rivalry between MINATOM and GAN will inevitably delay development of an effective and unified material control and accounting system. And while the system is slowly being built by a government beset with financial difficulties and rampant graft and corruption, struggling in an insecure world, it will be increasingly difficult for unpaid desperate employees to resist offers to pay a fortune for an unaccounted fistful of radioactive doom.

To understand the magnitude of the problem of trying to account for all the fissile material in the former Soviet Union one needs to understand that in the Cold War days, intimidation and strict control of physical movements in a police-type state were felt sufficient to ensure no theft or illicit diversion of fissile materials. These controls have largely disappeared. When the system collapsed there was nothing to take their place and no money to pay for any new physical

security systems. One expert has noted that "there are 950 sites for enriched uranium and plutonium in the former Soviet Union from the Western borders to the eastern peninsula."[40] Unless the Russians are more forthcoming in sharing information, particularly their database showing the individual signatures of the fissile material stockpiles, it will be virtually impossible to determine where the fissile materials seized in trafficking cases came from.[41]

It's difficult to understand why the Russians have not been forthcoming on cooperating with the US and European states to stop nuclear materials trafficking. Russian and US experts alike agree that Russian nuclear facilities lack the basics used in the West for guarding nuclear sites and radioactive materials, such as closed-circuit cameras, sophisticated coded locks, fingerprint authorization and movement sensors. Just as significant, these facilities have no effective method for tracking their nuclear inventory during processing, a key point of vulnerability. For example, it has been reported that in Tomsk-7, a facility in Siberia where weapons-grade plutonium is produced, "several hundred kilograms of plutonium have been lost without being registered [accounted for]."[42] MINATOM has been reluctant to acknowledge any major problems and despite some grudging progress its officials remain suspicious and closed-mouth -- notwithstanding high level acknowledgment of the security and accounting problems. Instead, MINATOM officials would rather bargain than share information to develop cooperative programs with the West.[43] Additionally, one Department of Energy expert noted, nuclear facility[44] managers in the former Soviet Union never put a high premium on accounting for inventories. Oftentimes, "surplus" plutonium was hoarded to ensure the "books were balanced."[45] This is because facility managers are held personally responsible for accidents or thefts involving nuclear materials.[46] Consequently, there is a marked reluctance to cooperate with efforts to trace the path of diversion, particularly when the trail would lead to your facility, thus adversely impacting on one's employment

future. This, of course, assumes that the facility manager was not involved in the actual diversion or smuggling incident--another reason why cooperation would be lacking.

2. Initiatives to Stop the Leakage of Fissile Materials

An ongoing joint effort by the IAEA, the European Communities Atomic Energy Agency (EURATOM), the US and other Western powers is to assist the Newly Independent States (NIS) of the FSU[47] in improving their systems for control of nuclear materials and relevant non-nuclear materials and equipment. The purpose of these "donor" programs is to substantially upgrade material control, accounting and physical protection systems at high risk facilities, and to engage responsible government authorities and facility personnel in a cooperative effort to achieve a national system of materials accountancy and physical protection. A number of the NIS have requested assistance from the IAEA and its members since the need for support in obtaining nuclear material control and physical protection systems is large and beyond their capabilities, in terms of both technology and finances, to institute a comprehensive system.

Although a number of donor countries have already executed bilateral agreements with individual recipient states, it quickly became apparent that in order to increase efficiency, avoid duplication of effort, and promote complete support, donor countries should coordinate their assistance and exchange information on technical requirements for support. The IAEA has served as a facilitator for this cooperative support effort, and as a result a number of "Coordinated Technical Support Plans" have been drafted and agreed to among donor and recipient states.[48]

The objectives of each plan are to identify the needs to be addressed, identify the time scale over which the program of work will be undertaken, and

identify areas of intended contribution by each donor country. These plans are comprehensive and emphasize the linkage between an effective state control system, nuclear materials accountancy, physical protection and export/import control; ensuring that each system is compatible with international requirements and guidelines. So far, this "donor" program is working well, although the US has appeared less willing than other donor countries to enter into cooperative assistance programs, preferring instead to focus on the bilateral relationships and implementing its material control and accounting programs with Russia.[49] Recently, the IAEA also met with Russian nuclear regulatory officials (GAN) to discuss ways in which Russia could also take advantage of the donor program, and MINATOM has also recently discussed with the IAEA possible cooperative material control and accounting projects.[50]

US concern over the physical protection, control, and accountancy of fissile materials in the FSU has resulted in the allocation of funds under the cooperative threat reduction program, also referred to as the Nunn-Lugar program, which was first authorized by Congress in November 1991,[51] and a number of other cooperative programs to assist those states that have nuclear programs where fissile materials are either produced, stored or used. Obviously, since Russia has the largest amounts of these materials and concerns about illicit diversion or theft from stockpiled materials are greatest, the US has focused primarily on Russia. However, as will be briefly described here, the IAEA and other nations are actively participating in programs with other states of the FSU to reduce the proliferation risk.

The US has taken a two-pronged approach to addressing the problem of uncontrolled or unaccounted for fissile materials in the FSU. First, the US has negotiated agreements with Russia to purchase its excess HEU as a non-proliferation and commercial venture. Second, under the cooperative threat reduction program and a parallel laboratory-to-laboratory program the US strategy

has been to provide monetary and technical assistance in improving facilities by deploying technology and instituting national standards and systems.[52]

Also, in cases of clear proliferation concern, the Clinton Administration has demonstrated a willingness to buy outright fissile materials, as it did when it secretly purchased and transferred 600 kilograms of HEU from Kazakhstan in November 1994.[53] Administration officials were worried that the material was poorly protected, and a cash-starved Kazakhstan might decide to sell the HEU to a proliferant country. There was sufficient HEU to make as many as 50-75 nuclear weapons. Consequently, the US paid "tens of millions of dollars"[54] to ensure this material was not used for nuclear weapons. President Clinton said the success of this operation "means that one more threat of nuclear terrorism and proliferation has been removed from the world."[55]

A number of programs are moving forward to alleviate the security, control, and accountancy problems with Russia's fissile materials. The Department of Energy (DOE) has provided funding to US nuclear laboratories to work with their Russian counterparts to develop, purchase and install up-to-date security systems. The DOE is funding about a half-dozen projects, and the US has been able to make some progress towards establishing a national material control and accounting system and helping individual facilities with their physical protection programs. One DOE official explained that the US strategy is to improve facility infrastructure and control over fissile materials, deploy technology to assist in bringing Russian facilities up to minimal IAEA standards, and institute national standards and systems for control and accounting of all fissile materials.[56] To date the effort has successfully resulted in securing three bombs' worth of nuclear material at the Kurchatov Institute, and a cooperative program with the formerly secret nuclear facility Arzamas-16 to develop technology which will fingerprint nuclear material and follow it for a lifetime.[57] As a follow-on, the US has plans to assist Russian authorities in securing tons of weapons-useable fissile

material at other facilities, deploying control, accounting and physical protection systems to additional facilities, and working with GAN to develop an agreement for cooperation which institutes national regulatory standards as well as control and accountancy systems.

This is an ambitious program whose major problem, besides MINATOM's intransigence and resistance to change, is funding. Recently, the United States provided an additional $20 million under the Fiscal Year 1995 Nunn-Lugar appropriation to buy sensors and other physical security equipment to help the Russians monitor highly enriched uranium and plutonium held in laboratories, research institutes and reprocessing facilities.[58] Furthermore, beginning in fiscal year 1996, the DOE, which has been designated to manage all funding for these activities, has requested $70 million to carry out these programs. The projected costs for the total program will be approximately $400 million and will stretch out over seven years.[59] Unfortunately, as one Defense Department official recently estimated, a five year program to develop safeguards and protections to adequately guard against thefts by rogue states or leaders of break-away republics would cost about $2 billion.[60] In addition, MINATOM claims it needs $1.3 billion to ensure the nuclear industry keeps on working--double the amount slated for the agency in the draft 1995 Russian budget.[61] Consequently, despite continuing efforts to remedy this problem, it is unlikely that adequate controls and safeguards will be satisfactorily implemented in the near term. We will have to live with the probability of theft or illicit diversion of uncontrolled and unsecured fissile materials for some time to come.

B. Nuclear Materials Trafficking: The Growing Threat of Illicit Fissile Material Diversions

While nuclear materials trafficking is not a new phenomena, the scale of activity has increased dramatically since the break-up of the FSU. The potential exists, given the situation in the FSU, for trafficking in nuclear materials to totally

overwhelm the current nuclear non-proliferation regime. Since 1991 the number of cases reported by Western European authorities has increased steadily. In 1994, a report submitted to President Yeltsin by the Russian Counterintelligence Service, the FSK, estimated that in the second half of 1993 there were 900 thefts from military and nuclear plants, and 700 thefts of secret technology.[62]

There have been sensational news accounts about the growing number of trafficking incidents.[63] The US Department of Energy has also closely monitored the dramatic growth in the trafficking of nuclear materials. DOE has concluded that since 1966 (first reported incident), of the over 450 illegal trafficking cases reported most have been "nothing more than profit motivated scams involving bogus material, which were perpetrated by opportunists and con-artists."[64] Nevertheless, the US government does acknowledge a number of significant characteristics of these trafficking cases--some disturbing--that can be summarized as follows:

- The number of incidents will likely continue to rise with more incidents involving special nuclear weapons materials (plutonium and enriched uranium).
- No material seized or reported stolen so far appears to have been stolen from nuclear warhead stocks.
- While there is speculation as to who the buyers are, there is no concrete evidence yet to substantiate specific clients.
- Smugglers are becoming steadily more sophisticated and the amounts being confiscated have risen from gram quantities to kilogram or greater quantities.
- Renegade military officers and civilian nuclear technicians from Russia, Ukraine and Romania are the principal suspects in the thefts of materials. These thefts tend to be "targets of opportunity." Contrary to media reports, there is no clear and convincing evidence yet that organized crime is directly involved in the diversion, smuggling, or sale of nuclear materials.[65]

Government and police authorities in Western Europe have claimed that they are succeeding in their efforts to stop, catch and deter nuclear materials traffickers. It is fatuous to assume, however, that law enforcement activities in this area can be any more successful than they have against drugs or other forms of illegal trafficking or smuggling. Indeed, what we have seen happening in Europe could just be the tip of the iceberg. As one authority has noted:

> Even if intelligence agencies and law enforcement are remarkably more successful in interdicting nuclear material than in interdicting other illicit products, it would be presumptuous to assume that they are able to seize more than sixty to seventy per cent. The implication is that at least one-third of the nuclear material that is stolen and traded illegally escapes detection and seizure.[66]

While no highly professional and sophisticated supply network has so far been discovered and no professional smuggling groups have been implicated, in all likelihood these groups have escaped detection and are using more direct routes to their prospective buyers in the Middle East.[67] One US official is reported to have stated: "If I were in Teheran or Baghdad and I am looking for Russian plutonium, the last place I am going to make a pickup is the country in Western Europe with the most sophisticated criminal investigation network and a government not unwilling to use it."[68] The more likely routes would be across the relatively control-free borders of ex-Soviet republics bordering Iran, Afghanistan, or Turkey.[69]

The main customers for nuclear weapons-usable materials are those states with covert nuclear weapons programs. As previously described, the acquisition of fissile materials provides a time-saving and economical way to short-circuit the nuclear weapons acquisition process. Despite strong measures to counter efforts to acquire these materials, a state determined to acquire them for its

clandestine nuclear weapons program will in all likelihood succeed. The most obvious and recent example of this is South Africa. The South African nuclear weapons program was carried out under strong UN sanctions and an international embargo. And yet, in about 10 years, involving roughly 400 scientists and technicians, it was able to develop and produce six nuclear weapons at a cost of about $900 million.[70] And as Iraq was to prove, a despot in search of nuclear weapons will let his people "eat grass" before he will give up those ambitions.

Consequently, despite either international legal commitments or international opprobrium, a number, albeit a small number, of "pariah" or "rogue" states, as well as transnational terrorist groups, will be in the market for weapons-usable fissile materials. Possible recipients of fissile materials smuggled across the porous borders of the FSU in Central Asia include Iraq, Pakistan, Iran and Libya.[71] Former director of Central Intelligence Robert M. Gates told Congress that countries such as Cuba, Syria, Algeria and India were also among those most likely to attract either former Soviet nuclear experts or be in the market for weapons-grade fissile materials.[72]

Next to Iraq and North Korea, Iran poses the greatest proliferation concern today. US intelligence officials believe that despite an embargo imposed by the West, Iran is aggressively pursuing the acquisition of nuclear weapons materials and technology and may have a nuclear capacity in as little as five years. Former CIA Director James Woolsey stated that "Iran is pursuing the acquisition of nuclear weapons despite being a signatory of the nuclear Non-Proliferation Treaty."[73] Surprisingly, the CIA's Russian counterpart, the Foreign Intelligence Service (FIS), generally echoed the CIA's assessment.[74] Intelligence agencies are so overwhelmed by the scope of the Iranian smuggling operation that it is almost impossible to monitor, let alone stop. "The Iranians spread their acquisitions program over a huge area. We were able to stop one recent acquisition only because we obtained the key numbers of the component they wanted to build on a

computer disk. Our best hope now is that we can delay the process. We will not be able to stop it," said a senior German intelligence official.[75] Indications are they are using old contacts and smuggling routes used in the past by the Pakistanis and the Iraqis to acquire nuclear weapons technology. The smuggling efforts are backed by Syrians and Pakistanis, according to German intelligence officials.[76] Breaking up clandestine shipments and sending parts on long, twisted routes, to include transferring cargoes in the dead of night in international waters, make it difficult, if not impossible, to follow and stop.

C. New Undertakings and Proposals to Combat Nuclear Materials Trafficking

Since 1991, the US and the member states of the European Union (EU) have undertaken a variety of new measures to respond to the clear and present danger of nuclear materials trafficking. In addition to assisting the states of the FSU in establishing effective material control, accounting and physical protection systems, [77] a number of cooperative and information sharing arrangements have been undertaken to stop and deter the growing trade in nuclear materials.

Germany, which has reported the most instances of nuclear trafficking, established a 20-member "nuclear office" in November 1994, and has deployed radiation detectors at major airports.[78] Yet currently, few European countries have the means to detect and halt radioactive materials at their borders. Consequently, the EU has recognized the need for greater cooperation and has already embarked on a program of information sharing and customs cooperation. authorizing the EU's new police intelligence agency, Europol, to investigate nuclear materials trafficking along with drug trafficking.[79] Additionally, Interpol, the global police alliance, is also collecting data in search of trafficker networks, and it is reportedly working with border guards and customs officials in several countries on how to deal with nuclear materials.[80] The IAEA has also established a data base to begin tracking and analyzing cases of trafficking and is providing technical support (to

include materials analysis), training and guidance on the physical protection and handling of nuclear materials.[81]

The United States has also developed a number of initiatives to track and respond to the trafficking threat. The CIA has formed a nonproliferation center and the Department of Energy has established a Threat Assessment Division to, among other things, track and analyze trafficking trends. The Department of Energy is also actively pursuing programs to cooperate with EU members, states of the FSU and others that request it in providing equipment to detect nuclear materials at border/customs points of entry, and to provide needed training and assistance to law enforcement agencies. It is also working on establishing a network of nuclear smuggling forensic laboratories.[82]

Cooperative measures have also been implemented among European nations and the states of the FSU. Germany and Russia agreed last summer to cooperate more closely on nuclear smuggling. They have begun establishing points of contact for intelligence sharing and agreed on methods for analyzing seized radioactive material. Germany has also signed a number of cooperative agreements with other Eastern European countries such as Bulgaria, Estonia, Hungary, Latvia, Poland, and Ukraine.[83] Because of bad publicity over nuclear smuggling incidents, coupled with Russian reluctance to cooperate in resolving these incidents, the Russians have become particularly sensitive to Western allegations that they are the sole source of nuclear materials on the black market. Subsequently, discussions on this issue have been undertaken in the G-7 forum and at the political level. Russia has been more willing to share sensitive information here than in other venues and it is able to use multilateral settings to present examples of possible fissile material thefts from other countries. The "G-7 plus Russia" have agreed to provide guidance to anti-smuggling efforts, enhance members cooperation, and support strengthening safeguards.[84] These

arrangements portend increased law enforcement efficiency in detecting illicit diversions of fissile materials.

Interestingly, few countries have comprehensive laws controlling the trafficking of nuclear materials, and what laws do exist often are inadequate to deter would-be traffickers. In Germany, for example, the federal police invoke the war weapons control act to assert jurisdiction and seize nuclear materials. That act, however, controls the production, transport and trade of war materials. Although a case could be made for kilogram quantities of plutonium or highly enriched uranium, trade in gram quantities raise questions as to the efficacy of this law to effectively prosecute and punish traffickers since such small amounts would not be considered "war" materials. This issue was raised last summer in Germany when German police seized 0.8 grams of HEU near Munich.

Austria's 1984 Foreign Trade law is used to prosecute smugglers, but only covers illicit transactions of nuclear materials indirectly. Poland's 1993 Export Control Law prohibits the unauthorized transit of fissile materials but the only remedy for violation is confiscation of the material. Turkey uses a 1918 law that governs vessels carrying hazardous materials for seizing nuclear materials. Other than confiscation, however, there are no criminal penalties. France, on the other hand, has strict laws on the possession and transport of nuclear materials.

To have any possibility of effectively stopping nuclear trafficking, the laws and regulations, to include penalties for traffickers, should be harmonized. This will prevent "jurisdiction shopping" by smugglers where, if caught, they would receive little or no punishment. One way to do this is for the IAEA to develop model legislation or, minimally, model provisions that all states could incorporate into their respective laws on smuggling. This could be done through convening of an international conference of interested states or regional organizations to help develop model legislation or provisions.[85] The proposed legislation would include measures for strict accountability and protection of

nuclear materials, licensing and regulatory requirements for the transportation and possession of such materials, and severe penalties for violation of any export control laws regarding nuclear materials. Convening an international conference to address this subject would also have the added benefit of improving consultation and information exchange among states, and would help "multilateralize" the process towards building a consensus on agreed measures to fight nuclear materials trafficking.

D. The Disposition Dilemma: Growing Stockpiles of Plutonium - A Legacy of the Cold War[86]

> The plutonium we no longer need for weapons is a global security risk and an economic liability.
>
> - Hazel O'Leary
> US Secretary of Energy[87]

The production and stockpiling of plutonium from civilian reactors is one of the world's sleeping disasters. While amounts depend on reactor types and sizes, all nuclear reactors produce plutonium.[88] As one expert warned:

> The greatest long-term threat to the treaty and the world may yet lie in the production and use of nuclear explosive materials in civilian commerce. If under the auspices of the treaty, civilian plutonium programs proceed as planned around the world, more than 500 metric tons of plutonium will be separated from the spent fuel of nuclear power reactors by the year 2010, of which at least 300 tons will be stockpiled as surplus.[89]

Weapon-usable plutonium includes plutonium separated from the spent fuel of commercial nuclear power reactors (reactor grade) and plutonium from nuclear warheads (weapons grade). Only about 5 kilograms (11 pounds) of weapon-grade or 7 kilograms (15.4 pounds) of reactor grade plutonium are required to make a primitive nuclear explosive device.[90] By 2010, there will be enough surplus plutonium from dismantled nuclear warheads to make more than

70,000 Hiroshima-size bombs--more than all the warheads currently in existence.[91] In addition, growing stockpiles of civilian or reactor-grade plutonium in Western Europe and Japan alone will be sufficient for 47,000 bombs, and highly enriched uranium from dismantled warheads would be enough for an additional 65,000 bombs. According to one reliable source, most of the world's 1,000 tons of plutonium are in civilian hands and yet only 30% (Britain, France, and the non-nuclear weapon states) is under international safeguards.[92] And while plutonium use will be uneconomical for the next 30-50 years,[93] billion dollar reprocessing plants in Britain and France continue to reprocess and separate on average 21 tons of plutonium a year.[94] By 2010 a total of 545 tons will have been separated,[95] mostly from Britain and France with Russia, China and possibly Japan also contributing.[96] Compare this to the approximately 150 tons of plutonium expected to result from the dismantlement of nuclear weapons. The point is that there is probably considerably greater danger in the long term to the United States and the Western world from existing fissile materials--particularly plutonium--than there is from a covert acquisition program in a country of proliferation concern.

Recently, the National Academy of Science's Committee on International Security and Arms Control at the request of the National Security Council (NSC), established a panel and produced a study on the "Management and Disposition of Excess Weapons Plutonium."[97] One of the Panel's most important recommendations was "using the immediate need to deal with excess weapons materials as an opportunity to set a standard of improved security and accounting that would be applied to all fissile materials worldwide."[98] Another key point was that plutonium in spent fuel from civilian power plants can be made into weapons. The fuel must first be reprocessed and its plutonium is more difficult to fabricate into weapons than is weapons-grade plutonium, but it can be done.[99] The most important protection against weapons use of civilian plutonium now embedded in

spent fuel comes not from the plutonium's different isotopic composition, compared to weapon plutonium, but from the bulk and intense radioactivity of the spent fuel (making it difficult and dangerous to steal) and from the chemical-engineering sophistication needed to separate the plutonium from the fission products and the uranium while avoiding lethal radiation doses to the people doing it.

While the focus of US efforts has been primarily on weapons grade plutonium from dismantled nuclear weapons, as one authority noted, it is not worthwhile to invest significant resources in safeguarding these materials, "unless and until society is also prepared to reduce further the accessibility of civilian plutonium in spent fuel."[100] What Dr. Panofsky and others are most concerned about is the continuing efforts on the part of the civilian nuclear energy industry to separate plutonium from spent fuel and store it for the possible--although highly unlikely--commercial use of the plutonium in civil reactors. Stopping reprocessing is one part of the solution equation. Addressing the stockpiles of plutonium from weapons and civil reactors even if not reprocessed is another problem. Long-term storage of excess plutonium at nuclear reactors or nuclear warhead sites is not practicable since it would entail significantly higher costs and pose a continuing risk of theft or damage.[101]

1. Possible Solutions

There are several approaches being proposed to address this problem, none of which is cheap or definitive.[102] All solutions so far proposed ultimately involve disposing of plutonium in geologic repositories. Cost figures vary[103] but they are hardly exorbitant sums in relation to the security benefits. There is no way to avoid paying a price for the processing and elimination of plutonium since to do nothing would have potentially catastrophic consequences both in terms of environmental contamination and proliferation risk.

Current options for disposition include vitrification, that is, commingling the plutonium with high-level radioactive wastes as these are melted into large glass logs for long-term underground storage.[104] So configured, the plutonium would be inaccessible to subnational groups or terrorists, and even a technically sophisticated proliferator would need considerable time and resources to recover it.

Another possibility is burial in deep boreholes. However, the only currently proposed repository is the Yucca Mountain site in the desert about 100 miles northwest of Las Vegas, Nevada. Environmental and safety concerns have delayed and may even derail the proposed 2010 opening of the repository that would have stored thousands of canisters of radioactive waste, including plutonium, in steel canisters for 10,000 years.[105] Another possibility for disposition is to use Canada's civilian nuclear power reactor, the deuterium-uranium CANDU, to efficiently and safely burn up plutonium from tens of thousands of US and Russian nuclear warheads dismantled as a result of sweeping arms reduction agreements. While plutonium would still be a by-product of this process there would be only about 25% of the current amount requiring long-term storage.

Absent concerted political efforts to resolve this problem now rather than later, the world will face not only an increasing proliferation risk but the potential for an environmental or terrorist-initiated catastrophe as a result of inadequate handling, mismanagement, theft or accident.

E. The Inadequacy of IAEA safeguards

> There is no way you are going to get adequate warning [of diversion] when you are talking about reprocessing plants, enrichment plants, or stockpiles of plutonium or highly enriched uranium.
>
> - Victor Gilinsky
> Former Nuclear Regulatory Commission Member[106]

Since the implementation of the NPT,[107] the IAEA has served as the leading agency for verification of nuclear non-proliferation.[108] General IAEA safeguards include materials accountability, containment (restricting access to and preventing clandestine movement of nuclear materials), surveillance and on-site inspections. Primarily through on-site inspections, the IAEA currently conducts safeguards inspections and verifies use of fissile materials at over 1000 facilities in over 50 countries.[109]

The theoretical goal of IAEA safeguards is to enable "the IAEA to conclude for a given period that no significant quantity of nuclear material has been diverted or that no other items subject to safeguards have been misused by a State."[110] A "significant quantity" is the amount of fissile material for which "the possibility of manufacturing a nuclear explosive device cannot be excluded."[111] For plutonium, a significant quantity is defined by the IAEA as eight kilograms; for highly enriched uranium (HEU) it is defined as twenty-five kilograms. It is well established, however, that this is much higher than needed to make a nuclear weapon. Modern nuclear weapons can be made from much less than that amount.[112] Indeed, some physicists have argued that as little as one kilogram of plutonium (about the size of "one sixth of a soft drink can") can be made into a 1-kiloton nuclear bomb.[113] Thus, the safeguards system is designed to meet criteria that are not sufficiently stringent to be fully effective, compounding the proliferation risk.

Unfortunately, for a number of technical and political reasons, the IAEA has not been able to meet the aspirations of its members concerned with the illicit diversion of fissile materials. A low point for the Agency was the post-Gulf War revelation of Iraq's nuclear weapons program; in contrast to the August 1990 finding by the Agency that Iraq was in complete compliance with its treaty obligations (the same month Iraq invaded Kuwait).[114] For years doubts have been expressed about the IAEA's ability to detect illicit diversions of nuclear materials

and the effectiveness of safeguards where substantial amounts of HEU or plutonium are involved.[115] Today, not much has changed as numerous experts have questioned the ability of the IAEA to safeguard existing reprocessing facilities.[116]

First, there are a number of technical problems with instituting 100% effective verification systems. As has been demonstrated time and again, it is an especially difficult task to apply safeguards at reprocessing plants with available technology only being able to account for 97 percent of plutonium throughput.[117] That leaves up to 3 percent of plutonium unaccounted for and subject to diversion for weapons purposes. As one expert has noted, in some facilities 3 percent is more than enough to make several nuclear devices per year.

> Thus meeting the inspection goal at these facilities by taking physical inventories, material balances and other quantitative accountancy measures is **not** sufficient to ensure that the diversion of a significant quantity of nuclear material has not occurred. In other words, there can be no firm assurance that enough plutonium for several nuclear weapons has not been or will not be diverted into clandestine nuclear weapons programs.[118]

Part of the problem has to do with the IAEA's theoretical goal of verifying that within a given period "no significant quantity of nuclear material has been diverted or that no other items subject to safeguards has been misused by a State."[119] The IAEA has conceded it cannot meet this goal, partly because of unavoidable technical uncertainties in measuring input and outputs of materials at a nuclear facility (especially reprocessing plants), and additionally because of the inability to accurately measure the amounts of material "stuck" inside the facilities.[120] As the IAEA has acknowledged, "due to measurement uncertainties, its material-accounting system cannot with confidence detect the diversion of bomb quantities of nuclear material."[121]

Second, the IAEA has been operating for over 10 years on a "zero-growth," fiscally constrained budget while the amount of fissile material under IAEA safeguards has been increasing at the rate of 10 percent per year. To quote one observer:

> Despite an 81 percent increase in the IAEA inspection force since 1980, the Agency's 211 inspectors must apply safeguards to [over] 1000 installations, an increase of 20 percent since 1980. During this period, the number of safeguards inspections a year increased nearly 100 percent, to about 2,200, and yet the Agency still cannot make as many inspection visits as it must to keep up with its workload and meet its own inspection goals.[122]

Consequently the IAEA's full-scope safeguards regime is overburdened and understaffed. IAEA safeguards arrangements in non-NPT nations are under even greater pressure because the agency's inspectors, whose role is limited to verification of inventories that are declared for inspection, cannot seek out clandestine activities or stockpiles.

F. Unabated Demand: Threshold States and Fissile Materials

> I . . . think nuclear weapons have much less political utility than anyone thinks they do, particularly those who are trying to develop them.
>
> - General Colin Powell
> Chairman, Joint Chiefs of Staff[123]

> Don't fight the Americans without nuclear weapons.
>
> - Indian Chief of Staff in response to a question about the lessons of the Persian Gulf War[124]

It is interesting to note that the industrialized West has rarely addressed the "demand side" of nuclear proliferation. Yet it is submitted that only a sincere concern about demand promises an end to proliferation. Supply-side controls are bound to fail in the long run because of leakage. Good controls may slow the

leaks, but they cannot stop them in an industrializing world. The main focus of US and international attention needs then to move beyond the symptoms of proliferation to its causes. It may seem easier to control supply, yet it is demand that raises the tide of proliferation. Supply side controls are small steps; they may be easy to implement but in the end supply side initiatives will only retard -- not prevent --nuclear weapon proliferation.

The demand side approach begins with serious attention to the needs and motives of nations that seek fissile materials and nuclear technology for their nuclear weapons programs.[125] Clearly, there is no single motive that explains the proliferation decisions of every country. Likewise, no single policy prescription will address every motive. Nevertheless, once one understands the reasons and motives of a particular country as it pursues a strategy of acquiring a nuclear weapons capability, strategies can be crafted to attenuate or roll back the demand for nuclear weapons. In this regard, it is worth considering what Munir Ahmad Khan wrote in 1990:

> The nuclear states should attempt to understand the motivation for some developing countries to retain their theoretical nuclear option. ...[T]he basic driving forces behind a nation's quest for nuclear weapons are its perceptions of security and national interests, as well as a sense of national pride, and we must appreciate that nation's own point of view if we are to take any effective steps to mitigate its concerns. Clearly, the smaller states of the world, particularly in regions where they are overshadowed by one or two regional powers, would have the greatest reason to feel insecure. Unless these legitimate security concerns of threshold states are met and dealt with effectively, the political and psychological incentives for them to retain a nuclear option will remain.[126]

Nuclear weapons may also serve as a symbol of military supremacy and technological achievement. It has not escaped the notice of less-powerful countries that the five permanent members of the UN Security Council, for example, are

also the five nuclear weapon states. If one possesses nuclear weapons or even is suspected of having a program then the result is more careful international attention to its interests (witness North Korea), and the attention of regional powers that comes with raw military power. The shortest route to regional respect may be through nuclear weapons.

It could be argued that "self-image" concerns motivated--at least in part--India to believe that a large country with an illustrious history should naturally have what other great nations have, including nuclear weapons. For example, the NPT and the non-proliferation norm it represents poses serious implications for India. Numerous opinion polls in India "confirm the overwhelming support among the India elite for giving up its nuclear weapons only when all other countries agree to do so at the same time."[127] This attitude will make it increasingly difficult for India to join the NPT or seek accommodation within the NPT. Certainly, if it should choose to go overtly nuclear India would risk courting international opprobrium, further isolating it. India's recent denunciation of the indefinite extension of the NPT as "perpetuating nuclear discrimination," and "conferring legitimacy on these double standards" is reflective of this attitude.[128] That may explain why India has tied further progress on a comprehensive test ban treaty to a set timetable for the elimination of all nuclear weapons while at the same time continuing its own nuclear weapons test program.[129]

States may decide that acquiring a nuclear weapon capability would be a useful bargaining chip to gain concessions. It may also give pause to outside powers to come to the aid of a victim of a nuclear armed aggressor. Even when both sides to a regional dispute have nuclear weapons, outsiders will likely be dissuaded from entering, concluding that a nuclear armed defender can take care of itself. Similarly, if nuclear proliferation increases the power and influence of any state, it must be expected that this will also increase the attractiveness of nuclear weapons for others. This may take the form of seeking alliances with

recognized nuclear states, but as additional states continue to develop the capability to manufacture technologically sophisticated products, making nuclear weapons easier to obtain, threatened nations may feel less inclined to accept the uncertainties of protection by allies, and the number of nuclear powers could thus become very large.[130]

1. Common Factors in Roll Back States

Since the advent of the nuclear age only six countries have voluntarily renounced their efforts to obtain a nuclear weapons capability. Two of these cases--South Korea and Taiwan--involved a special vulnerability to US diplomatic pressure. While all these cases differ in countless details, as well as in their historical and geographical settings, the other four cases--Argentina, Brazil, South Africa, and Sweden--had a number of common casual factors that may have utility as models for future "roll back" scenarios. When several of these factors appear in a proliferation problem country, it is reasonable to suspect that that country may be susceptible to efforts to cap, reduce, or cease some of the weapons-related nuclear activities in which it may be engaged.[131]

Argentina and Brazil[132] recently signed and ratified a bilateral agreement which established a joint nuclear materials accounting and inspection system administered by a new Argentine-Brazilian Agency for Accounting and Control of Nuclear Materials (ABACC). Subsequently, both Argentina and Brazil have ratified the NPT and have ratified the Treaty of Tlatelolco, the Latin American Nuclear Weapons Free Zone.[133] This is in stark contrast to the previous 20 years when Argentina and Brazil were not only engaged in a arms race and had clandestine nuclear weapons programs, but had often been among the harshest critics of nuclear weapons states (and the US in particular) with regards to the discriminatory nature of the non-proliferation regime enshrined in the NPT. What brought about this rather dramatic change in just a few short years?[134]

1. The return of civilian leadership in both nations provided impetus to nuclear *rapprochement* and to the evolution of their relationship to the nonproliferation regime. The leadership in both nations came to appreciate the potential benefits of reducing tensions generated by their respective nuclear programs.

2. The economic penalties of rejecting non-proliferation norms and the NPT, including denial of access to advanced Western technology, stimulated increased internal opposition to independent nuclear policies, particularly since both societies wanted to open their economies to foreign investment.

3. A number of international events occurred that seemed supportive of reversing course. These included US-Russian disarmament initiatives (such as INF, START), adherence to the NPT by France and China, and the dramatic reversal on nuclear weapons by South Africa.

4. Most importantly, the decision "grew out of the realization by the leadership of both nations that, whatever their differences, no rationale for possessing nuclear weapons existed, and that even the possession of so-called peaceful nuclear explosives would disrupt bilateral relations and destabilize the peace and security of the entire region." External pressure exerted by nuclear supplier states and the IAEA influenced the process, but only at the margins; it was never the determining factor.[135]

One lesson from this case is that external influences exerted by advanced nations are likely to be most effective in the form of incentives rather than penalties. Another lesson is also important, both symbolically and substantively: the value of bilateral or regional political machinery. Both nations strongly opposed the basic tenets of the nonproliferation regimes, especially the NPT and full-scope IAEA safeguards. But "[t]he development of a bilateral nuclear accounting and control system, as administered by ABACC, assured the necessary political insulation for the overt policy reversal."[136] The ABACC thus fulfilled a very real objective of providing mutual transparency to the nuclear programs of two highly competitive rivals. Such an organizational model could prove

particularly attractive to nations that, for whatever reason, distrust and resist IAEA safeguards or other international vice regional arrangements.

The Argentine-Brazil example represents a model for rolling back a nuclear weapons acquisition program but, if anything, the lesson is that absent a political climate conducive to change there is little likelihood that potential proliferators will emulate Argentina and Brazil.

2. The South Asian Case

India and Pakistan both can be considered de facto nuclear weapon states; India because it has exploded a nuclear device and has admitted that it could produce nuclear weapons in a few weeks if required,[137] and Pakistan because senior government officials have acknowledged it had the components and capability to assemble nuclear weapons.[138] India's presumed purpose in possessing nuclear weapons is to deter China and to maintain military superiority over Pakistan.[139] India is capable of extracting uranium and reprocessing spent nuclear fuel to separate plutonium, in addition to manufacturing explosives for nuclear weapons.[140]

Pakistan is also presumed to have sufficient weapons-usable fissile material to assemble at least ten nuclear weapons, perhaps in a matter of weeks.[141] Pakistan has developed this capability to counterbalance India's greater nuclear capability, to deter Indian's growing conventional superiority, and to gain international prestige by being the first Islamic state to acquire a nuclear weapon.[142] Pakistan has also been enriching uranium to produce HEU, is soon to begin (if it has not done so already) separating plutonium from spent fuel,[143] and it has signed a nuclear cooperation agreement with China in which the Chinese are reportedly assisting in nuclear bomb designs and providing fissile materials.[144] Pakistan is of particular concern for two reasons. First, it lacks the technical capability to fulfill its ambitious nuclear-weapon acquisition program since it

cannot produce sufficient quantities of weapons-usable fissile materials.[145] It will have to acquire them from foreign sources, either covertly from the FSU or directly from either China or possibly North Korea. Second, Pakistan has sought and continues to seek support for its confrontation with India from other Islamic states, especially Saudi Arabia.[146] It is possible that Pakistan in seeking financial aid could agree to share fissile materials, nuclear technology or information with other proliferant states in return for financial assistance.[147]

At present, it is unlikely that efforts on the part of the US and other Western states to halt or rollback either India or Pakistan's nuclear weapons program will produce positive results. Both acquisition networks will remain viable despite non-proliferation controls. As long as Pakistan has a security incentive for nuclear weapons (such as India's overwhelming conventional superiority and nuclear weapons program) there is little likelihood of successfully rolling back or stopping the program. India's acquisition program is also driven by security considerations, and as long as India perceives a Sino-Pakistani threat US efforts to quell India's nuclear weapons acquisition plans will have minimal effect.

One major distinction in South Asia, not present in South America, is India's perception that it must maintain a credible deterrent against a nuclear-armed China. India will not roll back its nuclear weapons acquisition program as long as it feels threatened by China's nuclear weapons capability. Additionally, in both Pakistan and India nuclear programs enjoy strong public support. While both governments have leaders committed to economic liberalization and seek foreign aid and investment, it is uncertain whether they would be amenable to the same kind of incentives offered Argentina and Brazil.[148] US efforts to have Pakistan and India agree to "cap" their programs have been pushed into the multilateral arms control arena.[149] A US proposal for both India and Pakistan--which actually proposed it first--to come to a five-power (US, China, Russia, India and Pakistan)

conference on non-proliferation has been stymied by India's refusal to attend, claiming to prefer an international solution to a clearly regional proliferation issue. India has also expressed little interest in establishing a regional NWFZ (except in the sense of prohibiting or restricting US presence), preferring to push global disarmament as a way to address its security concerns. US economic incentives and political "good offices" may push the process along but it will have only marginal effects in addressing regional proliferation concerns until larger regional security concerns are addressed.

While rollback remains possible and efforts to achieve this should continue, it is highly unlikely that US or other nation's efforts will succeed in the short term. Ultimately, it will be a combination of strengthened and expanding non-proliferation norms, along with enhanced "supply-side" initiatives, that will have the best long-term chance for success.

III. The Non-Proliferation Regime as a Framework for Controlling Fissile Materials

> We intend to weave nonproliferation more deeply into the fabric of our relationships with the world's nations and institutions. We seek to build a world of increasing pressures for nonproliferation, but increasingly open trade and technology for states that live by accepted international norms.
>
> - President William Clinton
> UN General Assembly, 27 September 1993[150]

A. The Non-Proliferation Treaty - A Big Part of the Cure

The Nuclear Non-Proliferation Treaty (NPT) established a global norm against the further proliferation of nuclear weapons. That norm is formalized in a binding treaty signed by most nations of the world. Remaining outside this treaty will increasingly bring on significant consequences in the form of political

isolation. Even though such consequences are "only" political, they become increasingly difficult to ignore--as witnessed by the fact that the NPT now has more than 175 members, the largest number of any arms control agreement.[151]

The recent agreement by the states parties to indefinitely extend the NPT[152] signifies, in part, the recognition by the non-nuclear, non-aligned states that the NPT is not just a lever for moving the nuclear weapons states (NWS) towards disarmament. It is rather a protective shield to ward off regional arms races and nuclear dangers. It is certainly not something the non-nuclear weapon states (NNWS) bestow on the nuclear weapon states, but rather something they need every bit as much as anyone else. Nuclear weapon states and non-nuclear weapon states alike have concluded that their own security interests are better served by an international regime in which it is preferable to have regional adversaries agree not develop or acquire a nuclear weapons capability than retain the option of developing such weapons themselves. The advantages gained from maintaining and being a part of this important international norm are many, and include:

- The security of knowing that their neighbors and regional rivals are not nuclear armed and will not be able effectively to pursue nuclear-weapons ambitions;
- the fiscal savings and sanity that come from avoidance of regional arms races;
- the lessening of the risk that nuclear weapons somewhere will be used (with tragic consequences to human life and the global environment);
- the meaningful security guarantees and assurances that stem from participation in treaties, security arrangements, regional regimes and global norms;
- access to trade in the fullest range of nuclear-related commodities and technologies.

The greatest benefit is, however, derived from normal political and economic relations by belonging to a global norm of nonproliferation. Such pressure can be very strong in a world that is becoming ever more interdependent, ever more tightly bound together by trade, politics, communications, the environment, security and other relationships.

Admittedly, the NPT is not perfect. For example, the NPT does not forbid a NNWS from possessing nuclear weapons. It forbids the acquisition of nuclear weapons but in theory a state that already has nuclear weapons could sign the NPT and not give up the weapons already in its possession.[153] But it has turned the development of a nuclear bomb into a violation of an almost universal norm, subject to international condemnation. Certainly, without the NPT there is little doubt that nuclear weapons would be much more prevalent than they are today. And, as former defense secretary James Schlesinger has pointed out, the "distinction" between NNWS and NWS "is not going to be eliminated.... It is in the interest of all the nations that desire stability for the United States to continue to have a deterrent sufficiently impressive to deter weapons use by other states."[154]

Much of this criticism comes from friendly and not-so-friendly nations habituated to flagellating the United States in disarmament conferences. These criticisms arise not because they fear the US's nuclear weapons but rather out of resentment over "nuclear imperialism" on the part of the US, and a desire to avoid the much more difficult problems associated with their own region's political instability. Nuclear weapon states as a whole are also taken to task for supposedly not seriously pursuing complete nuclear disarmament and ending the arms race.

A strong case, however, can be made that the NWS--certainly the US and Russia--have ended the nuclear arms race as called for by Article VI of the NPT. Both the US and Russia have decided to both unilaterally and cooperatively

(under the START I and as-yet-to-be-ratified START II agreements) withdraw and dismantle thousands of nuclear weapons. Over 2000 nuclear weapons are being dismantled every year and it will take at least until the year 2003 to achieve agreed reductions. Recently, Presidents Clinton and Yeltsin reaffirmed their commitment to "pursue negotiations in good faith on effective measures relating to nuclear disarmament, which remains [the] ultimate goal."[155] This "build down" process, however, has been generally ignored or criticized as too little and too late by those states that repeat the "discrimination" mantra, oftentimes in an effort to deflect world scrutiny over their own programs or acquisition efforts.

In discussions with nuclear energy officials and diplomats from lesser developed countries,[156] a number of complaints were made about the discriminatory nature of the safeguards regime, managed by the International Atomic Energy Agency (IAEA), the agency responsible for ensuring peaceful nuclear energy programs are not used for weapons development.[157] Specifically, the complaint is that the US and other NWS do not undergo IAEA safeguards inspections which includes onerous licensing, regulating and inspecting requirements. While from their point of view this argument may have some merit, it is more political posturing than a real complaint. It was again raised during the NPT negotiations.[158]

The US has a voluntary offer agreement in which it has agreed to put all civilian nuclear facilities under IAEA safeguards.[159] From a list of about 230 eligible facilities the IAEA has selected about three each year for safeguarding. Recently, however, resource constraints have prevented the IAEA from actually applying safeguards in the US. For the IAEA to inspect all US facilities would be inordinately expensive and require almost the entire current IAEA safeguards budget to implement. The US already has a comprehensive safeguards and physical protection regime required by law,[160] and the US spends close to a billion dollars a year ensuring material control and accounting and physical protection.

The real issue is more likely the disappointment expressed by some on the lack of technology, materials and information they expected to flow their way to help them develop nuclear energy and other nuclear-related activities once they signed up to the NPT and executed a IAEA safeguards agreement.[161] There is also frustration over the West's concern for implementing and strengthening IAEA safeguards at the perceived expense of providing direct assistance, or funding IAEA projects for nuclear research and resource development in lesser developed countries. This complaint also lacks substantive merit. The majority of the IAEA budget goes not to safeguards but to technical assistance and cooperation programs.[162] And the US and other developed countries have contributed over $40 million through the IAEA for specific technical assistance and cooperation efforts, directly supporting over 3000 such projects.[163] This does not include US-only programs for technical assistance to countries other than the FSU. Over 27 countries have technical cooperation agreements with the US, and the US has funded training and scientific and educational programs in almost 50 countries.[164] These cooperative efforts are only limited by US law that requires states to have all their peaceful nuclear facilities under IAEA safeguards in order to receive US exports of fissionable materials, reactors and technology.[165]

One of the main criticisms of the NPT by its supporters is that it allows some civilian nuclear programs that "can serve as the foundation of a nuclear weapons program."[166] Article IV of the NPT affirms the "inalienable right" of states to have research and production facilities to separate plutonium and enrich uranium. Therefore, it is argued that since there is currently no economically viable reason for separating plutonium, and given the disposition problems and proliferation risk, the Treaty should be amended or reinterpreted to ban production and reprocessing facilities. While these proposals are laudable it is unlikely any of the NWS would be willing to risk an amendment conference, particularly since it would invite other objectionable amendments that might dilute

the non-proliferation regime. The better approach would be to propose banning reprocessing and production in other non-proliferation measures such as nuclear weapons free zones.[167]

B. Strengthening Non-Proliferation Norms to Stop the Spread of Fissile Materials

> The policy of prevention through denial won't be enough to cope with the potential of tomorrow's proliferators.
>
> - Les Aspin
> Former Secretary of Defense[168]

There have been voluminous proposals regarding how the international community can strengthen non-proliferation norms, ranging up to and including the absolute ban on the possession of nuclear weapons. Whatever the merits of proposals banning nuclear weapons, it is judged here to be impractical for the near term. The following, however, are initiatives that have the best chance in the near term (5-20 years) for further enhancing the non-proliferation regime in the context of controlling and eventually stopping the spread of nuclear weapons-usable fissile materials. These initiatives, either in place or proposed, are not necessarily intended or expected to convince proliferant states that they should give up pursuing nuclear weapons. Rather, the idea is that it may make the utility of such a weapon as a coercive force less credible since other states will regard the use of such weapons as anathema and thus inviting a more credible threat of retaliation.[169]

1. Strengthening IAEA Safeguards

The IAEA has certainly, recognized that gaps exist in the current safeguards system, particularly since the Iraqi experience. IAEA officials have indicated that with the indefinite extension of the NPT and expanding nuclear

disarmament and arms control measures, all countries will demand that verification of compliance has high credibility.[170] Accordingly, it has undertaken a number of reform measures to strengthen the safeguards/verification regime since the disclosure of the Iraqi nuclear weapons program. Probably the most significant is the IAEA Board of Governor's decision in February 1992 to approve the IAEA's ability to conduct "special" inspections on short notice at suspected sites of diversion or other illicit, unsafeguarded nuclear activities.[171] Also decided and reaffirmed were members' authority and responsibility to share information on suspect activities that are in violation of either a member's NPT or safeguards agreement obligations.

Another significant event in strengthening the IAEA's verification capabilities occurred in December 1993 when the IAEA's Secretariat introduced a development program for a strengthened and cost-effective safeguards system. Called "Program 93+2," the aim of the program is to evaluate the technical, legal and financial implications for strengthening safeguards. The subsequent reports by the Director General of the IAEA contain a number of recommendations that will significantly strengthen the IAEA's ability to give assurances of non-diversion or take action in the event of non-compliance.[172] The proposed recommendations are detailed, technical and voluminous. If fully implemented they would address essentially all the criticisms leveled at the current IAEA safeguards system within today's technological capabilities. The recommendations were to be approved at the March 1995 Board of Governors meeting. The Board, however, after hearing concerns raised by some members over recommendations that included no-notice inspections at "undeclared" facilities, and involving greater physical access to declared sites, approved the report but deferred on the recommendations in order to consider them separately.[173]

A number of states, complaining of discrimination between NWS and NNWS, have expressed strong reservations about allowing the IAEA to look at

undeclared activities and then having reports and information found during these inspections made available to the NWS. If the IAEA is to be given the needed access to heighten confidence in a state's compliance with its safeguards agreement, then a way will have to be found to overcome these objections. One possibility would be for the IAEA to start with inspecting undeclared activities only at declared sites. This has deterrence value against proliferators since so far all the known clandestine weapon programs started at declared sites.[174]

Nevertheless, if the IAEA is to implement the proposed measures to strengthen safeguards it will require a budget increase. Despite a previous consensus by the Board of Governors to increase the contributions of members by 6 percent, a number of states have indicated reluctance to support any increases, claiming poverty because of stagnant economic growth at home. The Clinton Administration has committed to providing fund increases, and if the IAEA is to ever have a chance at becoming something other than the "dimwitted, toothless watchdog" it is accused of being,[175] measures to increase its ability to detect diversions of fissile materials must be implemented.

Yet even if the necessary funding is made available and the measures in "Program 93+2" are fully implemented, the problems with control and accountability of fissile materials in the FSU will remain. In addition, no matter how intrusive inspections or verification regimes may be, a determined proliferant state will still be able to clandestinely pursue nuclear weapons. As one of the inspectors of Iraq's program commented:

> The failed efforts of both the IAEA safeguards inspectors and national intelligence authorities to detect prior to the Persian Gulf War a nuclear weapons program of the magnitude and advanced character of Iraq's should stand as a monument to the fallibility of on-site inspections and national intelligence when faced by a determined opponent. The Iraqi [case]. . . is an experience rich in lessons that, if correctly understood may help in detecting other cover weapons programs and, equally important, U.S.

understanding of the limits of its ability to guarantee timely detection.[176]

2. A Fissile Material Cut-Off Regime

In his September 27, 1993 speech before the UN, President Clinton indicated that the US would press for a multilateral convention banning the production of fissile materials for nuclear explosives or outside international safeguards. Subsequently, the UN General Assembly adopted by consensus a resolution calling for the negotiation of a "non-discriminatory, multilateral and international effectively verifiable treaty banning the production of fissile material for nuclear weapons or other nuclear explosive devices."[177] The US has strongly supported this initiative in international fora and has urged the other NWS to support the concept.

The purpose of a "cut-off" treaty would be to strengthen nuclear non-proliferation norms by adding a binding international commitment to existing constraints on nuclear weapons-usable fissile material. As stated in the UN resolution, the proposed treaty would ban the production of fissile material for nuclear weapons or other nuclear explosive devices. It would not address stockpiles. It would be applied to fissile materials, and not to non-fissile materials, like tritium.[178] And finally, the current proposal would apply only to fissile material for explosive purposes and not to plutonium or HEU for non-explosive purposes. Thus, the convention would prevent the introduction of new fissionable materials to replace those removed from the US and Russian military weapons programs as warheads are destroyed. Such a cutoff could be verified relatively easily, and would not impose any significant burden on either the US or Russia.

The US has already discontinued the production of both plutonium and HEU, with the last plutonium production reactor being closed down in 1988, and has no plans to produce either material in the future. The Russians stopped producing HEU in 1989 and have agreed to close their last plutonium production

reactor down by the end of the century.[179] Russia has also announced its support for a cut-off treaty to cap the accumulation of fissile materials for nuclear weapons purposes.[180]

The primary goal of the cut-off treaty is to obtain the participation of those states who have unsafeguarded enrichment and reprocessing facilities (for example India, Pakistan, and Israel). The proposed treaty would also prohibit the transfer of fissile materials from the civilian nuclear cycle to the military cycle (in the case of NWS) or to unsafeguarded civilian cycles (for non-nuclear weapon states not parties to the NPT). It would require all parties to accept IAEA safeguards on facilities and materials concerned in order to verify the "non-production" of these materials. In sum, the proposed convention is addressed to nuclear powers and "threshold" nuclear states alike. For the former, it would involve a solemn undertaking, through a legally binding instrument, not to produce the material concerned, and thereby to participate in a disarmament measure. For the latter, it would lead to the freezing of their production and to the acceptance of safeguards on relevant facilities. Coupled with a comprehensive test ban treaty a fissile materials cutoff ratified by the eight states concerned would be an effective brake on further "vertical" as well as "horizontal" proliferation and would give significant impetus to maintaining progress in both the disarmament and nonproliferation fields. In other words, a fissile material cut-off treaty would support nuclear disarmament by NWS, reiterate non-proliferation commitments by NPT parties, and encourage threshold states to move closer to adhering to the non-proliferation regime.

Recently, the UK announced that it, too, had ceased the production of fissile material for explosive purposes despite having more limited quantities of such materials than the US or Russia.[181] The other nuclear weapons states, however, have been more equivocal. Both France and China have indicated a desire to maintain the possibility of production for national security purposes, and

are lukewarm about an extension of further international controls within their territories.[182]

In view of the consensus resolution in the UN, the Geneva based Conference on Disarmament (CD)[183] began work on developing a mandate for a committee to negotiate the cut-off treaty. After protracted debate the CD, on 23 March 1995, agreed to a mandate to begin negotiations. Unfortunately, the sometimes heated debate over a mandate has highlighted how difficult it will be to achieve a cut-off treaty anytime soon.

First, any cut-off regime will require extensive and intrusive verification measures that will be expensive. The IAEA estimates that comprehensive verification measures implemented in the eight states of concern (China, France, India, Israel, Pakistan, Russia, the UK, and the US) will cost approximately $140 million per year.[184] This is in comparison to the $67.5 million currently expended each year by the IAEA to conduct safeguards inspections. Dollar costs aside, a more difficult and politically explosive question is to what extent the NWS and threshold states will assume new obligations beyond traditional safeguards commitments to adequately verify their treaty commitments. Assuming the IAEA would be the inspecting and verifying body (a logical choice for expertise and cost reasons), the extent to which these states would allow a comprehensive verification regime (e.g. challenge inspections, visits to undeclared sites, extensive materials accounting) will need to be assessed, particularly since many IAEA member states have expressed serious reservations over current proposals to authorize IAEA access to undeclared sites.[185]

Second, some threshold states and others[186] have insisted that any fissile material control regime include banning all existing stockpiles and not just cap fissile material production.[187] This proposal will almost certainly delay, and possibly doom, the negotiations for a cut-off treaty. All of the NWS will oppose it, and India has already stated it will not accept expanding the scope to include

stockpiles.[188] Indeed, this was one of the issues that held up agreement on a mandate for negotiations. However, it is almost certain that Pakistan will propose this in the first meeting of the negotiating committee.[189] The reason Pakistan does not just want to cap existing stocks is because it wants to put pressure on India to either reduce their stocks or be allowed to build up to perceived Indian levels of fissile materials. Further, given the current view in Pakistan that the US is maintaining discriminatory policies against Pakistan in contrast to its relationships with India or Israel, any attempt to give in to US pressure will be seen as a sell-out by the Pakistan government.[190] Israel has not taken a position on a cut-off regime,[191] and it has never admitted to the production of fissile material for explosive purposes. It is possible that Israel would agree in the near term to freezing the production of fissile materials and placing its only nuclear reactor at Dimona under IAEA safeguards. That, however, is unlikely to satisfy the Arab countries which are more likely to be interested in the materials produced at Dimona over the last 30 years.

Third, there is the "legitimization" conundrum. Specifically, if the proposed treaty places no limits on previously produced fissile materials, it would be taken to indicate acceptance of past nuclear-weapon activities of the threshold states. Also, if the emphasis is on capping, rather than rolling back, these programs, that might be viewed as a weakening of opposition to nuclear proliferation. The proposed treaty, however, should not be seen as an alternative to the NPT or a regional non-proliferation regime for the threshold states. Its purpose is to cap the unsafeguarded production of fissile materials, not to legitimize the unsafeguarded production of these materials, nor to confer quasi-nuclear weapon-state status to threshold states. The cut-off treaty could be viewed as an interim arrangement or be portrayed as a commitment to future negotiations on nuclear disarmament and non-proliferation. Alternatively, the treaty could call

for the gradual placement of previously produced stocks of fissile materials under IAEA safeguards.

For example, the US has committed itself to submitting all excess fissile material to inspection and safeguarding by the IAEA.[192] In 1994, 10 tons of HEU and a small quantity of plutonium were submitted to IAEA inspections, and the Clinton Administration has recently declared an additional 200 tons of fissile materials as excess, some of which will ultimately be subject to IAEA inspections.[193] This amount represents almost 20 percent of all the fissile material produced in the US weapons complex.[194] As an additional openness and transparency measure, it would be useful for all NWS to declare the total amount of existing stocks. This would be further evidence of their intent to pursue their legal obligations under Article VI of the NPT to work towards nuclear disarmament. Additionally, the US and Russia have agreed to take a variety of bilateral steps aimed at expanding the coverage of safeguards on existing fissile materials and ensuring the transparency and irreversibility of the disarmament process. Negotiations are currently underway to develop a bilateral regime to inspect fissile materials from dismantled nuclear weapons.[195]

There is no doubt that a cut-off treaty that included the nuclear weapon and "threshold" states would facilitate further progress on both global and regional non-proliferation and disarmament measures. However, it is highly unlikely that there will be much progress made over the next few years. In addition to the seemingly intractable regional problems in South Asia and the Middle East that will preclude threshold state cooperation, most of the other lesser developed NNWS that are members of the Conference on Disarmament are at best ambivalent towards the idea of a cut-off treaty. Most states have pinned their security on the global non-proliferation norm or their own efforts at creating a regional nuclear weapon free zone rather than substantial progress toward a cut-off regime that would, at most, simply freeze existing fissile material stockpiles.

That does not mean, however, that the US should give up in its efforts. Like other non-proliferation initiatives the best opportunity for a cut-off treaty will come in the context of progress in other initiatives. It is more than possible that a gradual process of unilateral steps by the NWS, US-Russian bilateral arms control initiatives, and forward movement in a multilateral framework on issues like a comprehensive test ban will perhaps create a climate that will result in the successful negotiation of a treaty.

3. The Creation of Nuclear Weapon Free Zones

Nuclear Weapon Free Zones (NWFZs) strengthen nonproliferation norms and are a useful supplement to the NPT's verification structure and the IAEA safeguard system by allowing regional member states to call for inspections of another party if a treaty violation is suspected. For these reasons, the United States has long supported the concept of NWFZs as a disincentive to nuclear proliferation.[196] For example, the US has firmly supported the Latin American nuclear-free zone treaty,[197] subsequently signing and ratifying treaty protocols to the treaty: first agreeing to apply the provisions of the treaty to all US territories within the zone of application;[198] second, by providing a codified negative security assurance to all Latin American states-parties.[199]

NWFZs have been proposed for various geographical areas since at least the mid-1950s. Yet so far the Treaty of Tlatelolco (Latin America) and the Treaty of Rarotonga (South Pacific)[200] are the only established nuclear free zones in populated areas.[201] Although there is some disagreement over the essential elements of NWFZs, such zones usually combine: (1) commitments by the parties not to acquire, develop or possess nuclear explosive devices; (2) undertakings by nuclear weapons states (NWS) not to use or threaten to use nuclear weapons against states in the zone; and (3) agreement by both the parties and the NWS not to station nuclear weapons in the zone.[202]

The US has supported efforts to establish effective NWFZs in regions of real non-proliferation concern, such as the South Asian subcontinent, the Korean peninsula, Africa, and the Middle East.[203] This is in part because the US views such zones as a viable method of limiting the spread of fissile materials. For example, President Bush's Middle East Arms Control Initiative of May 1991 called on regional states "to implement a verifiable ban on the production and acquisition of weapons-usable nuclear material."[204] The US has also supported and encouraged the inclusion of a fissile material production ban in the December 1991 North and South Korea agreement, as yet to be implemented, to ban nuclear weapons on the Korean peninsula.[205]

NWFZs are an effective supplement to international efforts to prevent the spread of fissile materials for nuclear weapons programs and can help roll back proliferation where it has already occurred. The US should continue to encourage the inclusion of provisions banning the production or stockpiling of fissile materials in the proposed NWFZs. This is far preferable to risking protracted and politically risky efforts to amend the NPT at some future conference.

4. Export Control Regimes and the Harmonization of Export Control Laws

> We seek to build a world of increasing pressures for nonproliferation, but increasingly open trade and technology for those states that live by accepted international rules.
>
> - President Clinton
> UN General Assembly, September 1993[206]

One way the US and its Western allies have attempted to limit the spread of weapons usable fissile materials, and technology is through multilateral export control arrangements. Although it is conceded that even the most stringent of export controls will not succeed against a determined proliferator,[207] these multilateral arrangements do keep the costs of acquiring nuclear weapons capability high. While supply-side barriers can be overcome, they add a

substantial economic price, and also a penalty, because states suspected of embarking on nuclear weapons programs are denied the technology that might have been used quite legitimately for civilian purposes. States have also been denied financial aid, and, if sufficient information of proliferation exists, suffered economic sanctions. Although of questionable effectiveness, these penalties can clearly be very painful to a country to which they are applied; witness the current situation in Iraq.[208]

During the Cold War, the US and its partners used the Coordinating Committee on Multilateral Export Controls (CoCom) as the principal forum for reaching agreement upon restrictions on trade in nuclear materials and "dual-use" goods and technologies with communist countries. With the demise of the Soviet Union there was no longer a rationale for CoCom, and it ceased to exist on 31 March, 1994. While negotiations continue to develop a successor multilateral export control regime that would help prevent the transfer of nuclear weapons technology and materials to proliferant states or terrorists,[209] the primary multilateral arrangement for coordination of effort in this area continues to be the Nuclear Suppliers Group (NSG).[210] In serving as the coordinating body for controlling the supply of nuclear materials, equipment and technology, the NSG is a fundamental component of the nuclear nonproliferation regime.

The present agreement of the NSG centers around a "trigger" list of materials and equipment requiring full-scope safeguards as a condition for export, together with a supplemental list of 65 dual-use items added in 1992.[211] The NSG has adopted a set of supplier guidelines[212] that now includes requiring IAEA inspections and accounting of all fissile material in the recipient country, and the recipient country agreeing not to transfer such materials without the permission of the exporting country. These guidelines--more stringent than those required by NPT membership--are a key part of ensuring that fissile materials are not diverted

from those states that legitimately possess them for peaceful purposes to those that do not.

It is important, however, to also recognize the limitation of a voluntary export control arrangement like the NSG. The regime has been criticized in the wake of events in Iraq and North Korea, but in fact it does what it is designed to do: allow parties to keep track of what is going on and give, in most cases, timely warning of illicit diversions.

Because the NSG serves as a confidential information exchange forum to assist members in ensuring potential proliferators do not circumvent export controls, and because the guidelines restrict exports of nuclear materials and technologies to states that include non-nuclear weapons states and less developed countries, considerable resentment among potential client states has arisen. Some have decried the "discriminatory" nature of the guidelines and claimed that the NSG is nothing more than a cartel designed to ensure that "have not" states do not acquire the needed equipment and technology to develop a nuclear energy industry, and to inhibit their ability to cooperate in nuclear science and technology programs.

One possible solution to these complaints would be to have the NSG set up a consultative committee for prospective recipient states This committee would be a forum for states to air their complaints officially to members of the NSG. The NSG would then respond to these complaints confidentially or publicly, as the case may be, to explain the rationale for their resulting actions. In certain instances, the NSG could make exceptions to its guidelines, if warranted, or change them if an injustice has been done. This committee would not be a negotiating forum between importing and exporting states. It would simply be a forum for passing information and raising issues for discussion by the NSG, with possibly an obligation on the part of the NSG to respond to any demands or questions put to them by the importing state.[213]

Surprisingly, despite years of cooperation in controlling sensitive technologies and nuclear materials, states participating in these multilateral regimes have not enacted export control laws that are either standardized or sufficient for their NSG commitments. Ineffective export control laws in Europe and elsewhere have unwittingly assisted nuclear weapon aspirants in obtaining the materials and technology needed for their clandestine programs. For example, one study discovered the striking disparity in the structure, implementation and enforcement of the nonproliferation export controls of the FRG [Germany], the UK, France, Italy and Japan. Part of the reason for this is that export control groups, such as the NSG, operate on voluntary restraints. Unfortunately, these "gaps" have been exploited by fissile material traffickers and agents of proliferant states searching for materials, equipment and technology to advance clandestine weapons programs, thus undermining the entire multilateral cooperative arrangement.[214]

While European Union members have made progress in harmonizing lists of controlled items and countries to be excluded from nuclear and dual use transfer, eastern European states and those of the FSU have lagged behind in developing adequate export control laws and regulations. Western states, including the US, have developed programs of assistance to slowly bring those states where nuclear technology, expertise, and materials exist into compliance with NSG guidelines, and most of these states have professed an eagerness to do so. Trade and sharing technology are the primary incentives. It should be noted that the US government has also been criticized for failing to adequately investigate potential recipients of dual use nuclear items, or to follow up to ensure such exports are not diverted to develop nuclear weapons.[215] This is due, in part to the extremely complex nature of trying to control and regulate a vast interconnected network of trade and commerce. While export controls on items other than fissile materials are beyond the scope of this paper, one should

recognize, that if gaps exist in export control regimes it is all the more likely that the illicit diversion of fissile materials could occur undetected.

Another way to deter smuggling and accelerate coordination efforts would be to negotiate an international convention or treaty making the smuggling of fissile materials a crime against international law.[216] A treaty regime would have several advantages over and augment the NSG export control mechanism. It would be non-discriminatory and universal. It would create an international legal norm that would reflect world opprobrium over this activity. As with most treaties that address criminal or terrorist activities,[217] it could include a "prosecute or extradite" provision; states parties would be obligated to criminalize smuggling activities and prosecute smugglers or extradite them to a state that will. States would be obliged to return smugglers to other states where they might have committed criminal activities even though they had not committed any crimes in the state where they reside. Finally, a treaty regime would open up additional avenues for cooperation and information sharing among states to interdict and stop smuggling and possibly inhibit their clients from choosing this method of acquiring fissile materials.

V. Conclusion: No Easy Solution

> The unleashed power of the atom has changed everything save our modes of thinking, and thus we drift toward unparalleled catastrophes.
>
> - Albert Einstein[218]

A number of experts in this area confided that it may very well require some catastrophic event similar to the Oklahoma City bombing disaster in order to energize the international community to work in concert to eliminate this problem. It is an unfortunate fact that the US government, as well as other governments and the American people, tend to react to situations rather than anticipate them. The

danger is so great and the threat so immediate that US policy-makers and the public need to recognize the illicit diversion of fissile materials as a critical and urgent national security priority, one that will require top-level attention, public education and sufficient resource allocation if we are to eventually prevail over this new security challenge. One can only hope that a tragedy will not be necessary for galvanizing the world to action, and that we will achieve progress toward an international consensus that it is in nobody's interest to acquire these materials for illicit purposes.

The US needs to start now exercising the requisite political leadership to begin building a system of regional security institutions, capped by the United Nations, that would promote essential habits of cooperation among the nuclear weapon states and that could lower the incidence of armed conflict in the world. Enhancing existing norms through strengthened security assurances, cooperative export control arrangements, and binding agreements on capping fissile material production could push forward the frontiers of the international legal order.

In examining current efforts and an exhaustive list of "new ideas" on how to stop the proliferation of fissile materials, it is hard to see how any strategy, no matter how clever the conception or assiduous the implementation, could do more than ameliorate the fundamental problem. The problems of the FSU are too diverse and complex to solve overnight, nor can the US buy up all the fissile material that is of proliferation concern, although it would be wiser and in the long run cheaper to try, rather than spending trillions later to defend against potential future use of these materials in weapons. And, since no country can hope to match the US in conventional arms, US success in the Persian Gulf War had the unexpected consequence of sowing the seeds of future nuclear proliferation, even as it uprooted one of the more dangerous threats.

Of course, that is not to imply that our non-proliferation efforts are of no avail. In many respects the non-proliferation regime has been successful,

particularly when one evaluates it against the likely result of its absence. A number of countries, Argentina, Brazil and South Africa being the most recent, have given up their nuclear ambitions. There is no denying, however, that a number of states are actively, if covertly, seeking the wherewithal to manufacture nuclear weapons. One needn't be a pessimist to understand that through a combination of regional factors, gaps in the non-proliferation regime, and, at times, an indifference to the problem by Western--and most other—states, the likelihood has grown that within the near future (five to ten years) there will be a political crisis involving a newly-armed nuclear state or terrorist group.

While unprecedented progress has been made in global and regional non-proliferation measures, we must not allow that progress to blind us to the fact that in an imperfect world no amount of effort will stop a determined proliferator. Consequently, the US--as the only state capable of doing so--must be prepared to respond effectively when those proliferation threats do occur. Ultimately there will be no "silver bullet" to stop the spread of fissile materials. No system is foolproof. Control over nuclear weapons in general and fissile materials in particular will require the continuous and simultaneous exercise of several measures, ranging from national intelligence gathering to international regime building, regional conflict resolution and selective coercive measures--to include in limited instances the use of force.[219] Recent experiences with Iraq and North Korea demonstrate the necessity of being adequately prepared to respond to proliferation threats.

Those that believe the effort is not worth it, that the continuing spread of fissile materials is inevitable, are wrong. Tough "supply-side" controls can close the spigot to a slow drip while time and commonality of interests in non-proliferation can change the political motivation to acquire nuclear weapons. Eventually, it is hoped that a seamless web of measures will result in the international community as a whole exercising the political will to stop, and ultimately end, the threat of a fissile material catastrophe.

ENDNOTES

[1] William J. Clinton, "Remarks by the President at U.S. Air Force Academy Graduation Ceremony," White House Office of the Press Secretary, May 31, 1995, p. 5.

[2] Hank C. Jenkins-Smith, Kerry G. Herron, and Richard P. Bark, *Public Perspectives of Nuclear Weapons in the Post-Cold War Environment*, SND94-1265 (Sandia National laboratories, Albuquerque, N.M., April 1994).

[3] The term traditionally refers to nuclear, chemical and biological weapons and the means to deliver them.

[4] The US Department of Defense's *Bottom-Up Review* of October 1993 viewed the proliferation of weapons of mass destruction (WMD) as the most urgent and direct threat to US security in the emerging era. President Clinton's recent *A National Security Strategy of Engagement and Enlargement* (February 1995) called WMD "a major threat to our security and that of our allies and other friendly nations." p. 13.

[5] Highly enriched uranium (HEU)-235 is for use in bombs and some research and submarine reactors. U-235 is an isotope of uranium that is easiest to split in a reactor or bomb. It comprises only about 0.7 percent of natural uranium, but isotope separation via gaseous diffusion or centrifugation commonly "enrich" it to "weapons-grade" concentrates. Plutonium, an element that exists in only trace amounts in nature, is manufactured in reactors by bombarding atoms of uranium isotope U-238 until they absorb a neutron and become Plutonium 239. PU-239 is the best isotope for making bombs but any isotope of plutonium, while less efficient, can be used for bombs.

[6] Unless otherwise indicated, the terms "fissile materials" or "weapons-usable fissile materials" refers to weapons-grade HEU or plutonium. The term "nuclear materials" include all materials, including fissile materials, associated with the production (to include by-products) of nuclear programs for energy and/or weapons.

[7] Dr. Richard Garwin, National Academy of Sciences, *Statement Before the Panel on Military Application of Nuclear Energy*, Committee on Armed Services, House of Representatives; Hearings on National Defense Authorization Act for Fiscal Year 1995, H.A.S.C. No. 103-39 (Washington: U.S. Government Printing Office, 1994), 568.

[8] See J. Carson Mark et al., "Can Terrorists Build Nuclear Weapons?," in Paul Leventhal & Yonah Alexander, eds., *Preventing Nuclear Terrorism* (Lexington MA: Lexington Books 1987): 60-62.

[9] Marilyn Greene, "Japan Cult Shopped for Nuclear Weapons," *USA Today*, 1 November 1995, p. 1.

[10] Luis Alvarez, *Alvarez: Adventures of a Physicist* (New York: Basic Books 1987): 125.

[11] William J. Broad, "Experts in U.S. Call Plutonium Not Arms-Level," *New York Times*, 17 August 1994, p. A1. See also William J. Broad, "Blix Says IAEA Does Not Dispute Utility of Reactor-Grade Pu for Weapons," *Nuclear Fuel*, 12 November 1990, p. 8; J. Carson Mark, *Reactor-Grade Plutonium's Explosive Properties* (Nuclear Control Institute, August 1990).

[12] "U.N. Official: Iraq Worked on Radiological Arms, " *The Washington Post*, 8 November 1995, p. 25.

[13] Office of Technology Assessment, Washington D.C., U.S. GPO: *Proliferation of Weapons of Mass Destruction: Assessing the Risks*, August 1993, pp. 10-11, 33, and *Technologies Underlying Weapons of Mass Destruction*, December 1993: 119-120, 126.

[14] See Richard Rhodes, *The Making of the Atomic Bomb (*New York: Simon and Schuster 1986): 886.

[15] See Peter D. Zimmerman, "Proliferation: Bronze Medal Technology is Enough," *Orbis* (Winter 1994): 67.

[16] *Ibid.* While reactor designs vary considerably, they all have common characteristics; among them being they consume only a part of the nuclear fuel that powers them. The spent fuel typically contains isotope U-235 at higher concentrations than the original uranium plus plutonium. See *Fissile Material Cutoff Treaty Negotiator's Databook* (U.S. Government: Department of Energy 1994) Chapters 3-5.

[17] See *The Defense Counterproliferation Initiative,* Memorandum from the Secretary of Defense, December 9, 1993; *Report on Nonproliferation and Counterproliferation Activities and Programs,* Office of the Deputy Secretary of Defense, May 1994; Zachary S. Davis, *Non-Proliferation Regimes: A Comparative Analysis of Policies to Control the Spread of Nuclear, Chemical, and Biological Weapons and Missiles,* Congressional Research Service, Washington D.C., February 18, 1993; George H. Quester and Victor A. Utgoff, "Toward an International Nuclear Security Policy," The Washington Quarterly, (Autumn 1994): 5-18. For opposing views on US Counterproliferation efforts see Harald Muller and Mitchell Reiss, "Counterproliferation: Putting New Wine in Old Bottles," *The Washington Quarterly* (Spring 1995): 143; David Fischer, "Forcible Counterproliferation: Necessary? Feasible?" in Mitchell Reiss and Harald Muller, eds, *International Perspectives on Counterproliferation,* Working Paper No. 99 (Washington D.C.: Woodrow Wilson Center, January 1995).

[18] Quoted in Oleg Bukharin and William Potter, "Potatoes Were Guarded Better," *Bulletin of Atomic Scientists,* (May/June 1995): 48.

[19] For an excellent analysis of the conditions resulting from the breakup of the Soviet Union see Susan B. Chodakewitz and Jill L. Jermano, *Regional Instability, Proliferation and the Former Soviet Union,* Defense Nuclear Agency Technical Report, DNA-TR-92-199, December 1992.

[20] Approximately twenty-two countries possess or control separated plutonium either for military or commercial use. See David Albright, Berkhout and Walker, *World Inventory of Plutonium and Highly Enriched Uranium* (New York: Oxford University Press, 1992).

[21] Charles J. Hanley, "World Fears Spread of Nukes," *Associated Press [Online]*, 28 March 95. Available NEXIS Library.

[22] Jonathan Dean, "The Final Stage of Nuclear Arms Control," *The Washington Quarterly* (Autumn 1994): 39.

[23] "Russia's Yard Sale," *Time,* 18 April 1994, p. 28. See also Michael R. Gordon "Russian Controls on Bomb Material Are Leaky," *New York Times,* 18 August 1994, p. A1; Graham H. Turbiville, Jr., *Mafia in Uniform: The 'Criminalization" of the Russian Armed Forces,* (Foreign Military Studies Office, Ft. Leavenworth, Kansas, July 1995).

[24] Alexander Rossolimo, "Nuclear Blackmail; What's the Response," *Commentary* (International Strategy Associates, 1994): 7.

[25] *Ibid.* The author cites a report in the Russian newspaper *Izvestia* claiming 70-80% of all private enterprises are victims of extortion, and quotes FBI Director Louis Freeh in testimony before the U.S. Senate in May 1994 in which he said that Russian criminal organizations are more than capable of stealing and selling nuclear weapons-grade materials.

[26] The so-called "brain drain" problem and US and other Western powers efforts to find productive work for nuclear weapons scientists and engineers is well documented. See e.g. Elaine Sciolino, "Soviet Brain Drain Poses Atomic Risk, U.S. Report Warns," *New York Times*, 1 January 1992, p. 1; John R. Deni and Anne M. Harrington, "Beyond Brain Drain: The Future of 'Nonproliferation Through Science Cooperation' Programs," Paper presented at the *Conference on New Frontiers in Arms Control*, Center for International and Security Studies at Maryland School of Public Affairs, University of Maryland, 30-31 March 1995. As noted previously, this paper does not address the possibility of the theft of sale of a nuclear weapon to a proliferant state. While some believe that Russian nuclear weapons remain under close control and are adequately secured (See e.g. Leonard S. Spector, Testimony to the Subcommittee on International Security, International Organizations and Human Rights of the Committee on Foreign Affairs, *Hearings on Russian Organized Crime and Nuclear Security*, U.S. House of Representatives, June 27, 1994), a number of US Government officials have indicated to the author that there are serious security and management problems at Russian nuclear weapon storage facilities. See Doyle McManus, "Unwanted Russian Warheads, A Prize Waiting to Fall into Wrong Hands," *Los Angeles Times*, 9 May 1994, p. 14.

[27] See Ian Glover-James, "Third World Dictators Woo Soviet Scientists," *The Sunday Times* (London), 13 October 1991, p. 20 (Syria, Libya, Iraq and North Korea actively trying to hire nuclear weapons scientists and engineers); "Exodus of Soviet Nuclear Scientists Assessed," *Soviet Union: National Affairs FBIS Report* FBIS-SOV-91-200, 16 October 1991, 43-45; "Russian Ministry Opposes Scientists' Hiring," *INTERFAX*, 21 January 1992; FBIS, SOV-92-014, p. 1 (Libya offered contracts to nuclear physicists at the Kurchatov Nuclear Research Institute).

[28] "President Report Views Brain Problem," ITAR-TASS broadcast, 9 April 1993, *FBIS Daily Report*, FBIS-SOV-93-067, p. 39.

[29] Deni and Harrington, *supra*, note 24 at 5, see endnote 6.

[30] See *infra* notes 85-103 and accompanying text.

[31] Bette Hileman, "U.S. and Russia Face Urgent Decisions on Weapons Plutonium," *Chemical and Engineering News*, 13 June 1994, p. 14.

[32] Charles J. Hanley, "Russian Nuke Security Examined," *Associated Press [Online]*, 28 March 95. Available NEXIS Library.

[33] *Ibid.*

[34] Oleg Bukharin and William Potter, "Potatoes were guarded better," *The Bulletin of Atomic Scientists*, (May/June 1995): 49.

[35] Interview by the author, March 15, 1995.

[36] Assessment by the author based on interviews and discussions with numerous DOD, DOS, ACDA and DOE officials confirms the author's views.

[37] "A Look at Russia Nuke Watchdog," *Associated Press [Online]*, 26 March 1995: Available on NEXIS Library.

[38] GAN was created in 1992 as an independent nuclear oversight organization, similar to the US's Nuclear Regulatory Commission. In an April 1993 decree, President Yeltsin reaffirmed GAN's authority to inspect all

nuclear facilities, including those controlled by both the Ministry of Defense and MINATOM. Both ministries have fought oversight by GAN and it is uncertain if President Yeltsin has the power to enforce his decree. See "Russian Energy, Defense Ministries Oppose Nuclear Inspections." *INTERFAX*, April 28, 1993, cited in *FBIS Daily Report*, JPRS-TAC-93-004-L, May 3, 1993, p. 2.

[39] "A Look at Russia Nuke Watchdog," *supra* note 58.

[40] Jane Perlez, "Tracing a Nuclear Risk: Stolen Enriched Uranium," *New York Times*, 15 February 1995, p. A3.

[41] *Ibid.*

[42] Margaret Shapiro, "Russia Orders Tightened Security to Protect Nuclear Materials," *Washington Post*, 24 February 1995, p. A15 (Russian officials acknowledge the need to modernize and tighten controls at nuclear research and production facilities).

[43] *Ibid.*

[44] This includes laboratories, nuclear reactors and research and testing facilities.

[45] Interview by author, 14 March 1995. See also *FBIS Daily Report: Central Eurasia*, "Nuclear Expert Describes Security Measures as 'Outdated'," FBIS-WEU-94-186 (September 26, 1994), 14.

[46] Interview by author of Department of Energy (DOE) official, 14 March 1995.

[47] NIS does not include, by definition, the Russian Federation. As a nuclear weapon state, Russia has been resistant to IAEA assistance in developing a national material accounting and physical protection system.

[48] Plans have been drafted for Belarus, Latvia, Kazakstan, and Ukraine. Donor countries include Hungary, Sweden, Finland, Japan, UK and the US.

[49] Interview of IAEA Director of External Relations, 21 March 1995.

[50] Interviews with IAEA officials, 21 March 1995.

[51] Public Law 102-228. An excellent summary of the legislative history and its implementation of this law may be found in Theodore Galdi, "The Nunn-Lugar Cooperative Threat Reduction program for Soviet Weapons Dismantlement: Background and Implementation," *Congressional Research Service Report 93-1057F* (Washington, DC: The Library of Congress, December 29, 1993). In Fiscal Year 1994, the Nunn-Lugar funding became an additional line item in the DOD budget.

[52] In 1992 the US Enrichment Corporation was created by Congress to, among other things, oversee an agreement with Russia in which the US agreed to purchase 500 tons of HEU from Russia. Established by Congress as part of the Energy Policy Act of 1992, this is a semi-autonomous corporation that will eventually become wholly private. The Corporation is empowered to set prices on uranium and sell it to users at rates it establishes. It is in effect a monopoly. See Atomic Energy Act, as amended, 42 U.S.C. § 2297b. The US and Russia signed an agreement on February 18, 1993 for the US to purchase about 500 tons of HEU over the next 20 years. Arrangements were to be worked out to ensure that the HEU came from dismantled nuclear weapons. The HEU is to blended down to produce low-enriched fuel for nuclear reactors. See Oleg Bukharin, "Soft Landing for Bomb Uranium," *Bulletin of Atomic Scientists* (September 1993): 44.

[53] The operation was codenamed "Sapphire." See Michael R. Gordon, "U.S., in a Secret Deal, Removes Bomb Fuel in Ex-Soviet Republic," *New York Times,* 23 November 1994, p. A1.

[54] Steven Erlanger, "Kazakhstan Thanks U.S. on Uranium," *New York Times,* 25 November 1994, p. A10.

[55] "Operation Sapphire," *Maclean's,* 5 December 1994, p. 35. Defense Secretary Perry is also quoted here as saying that "some of this material was in the form that could be used directly to make nuclear weapons."

[56] Interviews with DOE officials, 13 March 1995; *DOE Fact Sheet on Nuclear Material Protection, Control and Accounting Cooperation with the Russian Federation* (undated).

[57] *Ibid.*

[58] "More Aid to Russia for Nuclear Security," *New York Times,* 25 January 1995, p. A6.

[59] Interviews with DOE, DOD, ACDA officials, 13-15 March 1995. Previous year funding for this effort has included $30 million (Nunn-Lugar) for the government-to-government program, and $17 million for the lab-to-lab program ($2 million in FY 94 from DOE, and $15 million in FY 95 from Nunn-Lugar). *DOE Fact Sheet, supra* note 233.

[60] Susanne M. Schafer, "Pentagon: Five Years to Corral Former Soviet Nuclear Arsenal," *Associated Press News Service [Online]* February 22, 1995: Available NEXIS Library. This is probably a conservative estimate. For example, in the last decade the US has spent $7 billion to enhance its own nuclear facility security. See William J. Broad, "U.S. Energy Chief Calls for Help for Russia on Atomic Security," *New York Times,* 18 August 1994, p. A11.

[61] "Russia orders extra security at nuclear sites," *Rueters News Service [Online],* 23 February 1995: Available LEXIS Library.

[62] *FBIS JPRS Report: Proliferation Issues,* "'Secret Report' on Nuclear Proliferation," JPRS-TNT-94-003-L (May 4, 1994), 20. The report also details the sorry state of Russian security and control measures to safeguard nuclear materials.

[63] For a detailed listing and assessment of these news accounts see Phil Williams and Paul N. Woessner, "Nuclear Material Trafficking: An Interim Assessment," *Ridgeway Viewpoints,* 95-1, 1995. Cases of smuggling have continued unabated into 1995. See e.g. "Russian Uranium Simple to Steal, Court is Told," *Reuters World Service [Online],* February 15, 1995: Available NEXIS Library (Reports that Russian authorities 8 kg of HEU stolen from nuclear plants in the past year); Jane Perlez, "Tracing a Nuclear Risk: Stolen Enriched Uranium," *New York* Times, 15 February 1995, p. A3; Craig R. Whitney, "Smuggling of Radioactive Material Said to Double in a year," *New York Times,* 18 February 1995, p. A2; D'Vora Ben Shaul, "Exposed: Smuggling," *The Jerusalem Post,* 20 March 1995, p. 7; Charles J. Hanley, "Part I: Nuclear Traffickers," *Associated Press [Online],* March 24, 1995: Available NEXIS Library; "Police Confiscate Uranium Stash from Ex-Soldiers," *Associated Press [Online],* March 22, 1995: Available NEXIS Library; "Slovak Uranium Seizure," *New York Times,* 26 April 1995, p. A13.

[64] U.S. Department of Energy, *Black Market Trafficking in Nuclear Material: 1993 & 1994 Transactions,* Office of Nonproliferation and National Security, Threat Assessment Division, March 1995. One scam deserves mention; offers of so-called "Red Mercury" claimed to be an essential ingredient in both nuclear weapons and weapons guidance systems. Experts are convinced the material is non-existent. Samples offered by sellers have been either mercuric oxide or mercuric iodide neither of which is radioactive, valuable or used

in nuclear weapons. See e.g. Vladimir Orlov, "Black Holes of Red Mercury," *Moscow News,* August 13, 1993, p. 11; FBIS *JPRS Report: Proliferation Issues*, "High-Level Involvement in 'Red Mercury' Scam Alleged," JPRS-TND-94-006-L (August 5, 1994), 30-34. The "red mercury" scam has had tragic consequences. It was reported that at least 78 people were killed in Namibia trying to dismantle conventional weapons supposedly containing red mercury worth up to $300 per kilogram. Department of Energy, *Black Marketing Report, supra* at 14.

[65] DOE *Black Marketing Report, supra*; Craig Whitney, "Smuggling of Radioactive Material Said to Double in a Year," *New York Times*, 18 February 1995, p. 2; James Woolsey, *Statement before the Subcommittee on International Security, International Organizations and Human Rights of the Committee on Foreign Affairs,* June 27, 1994.

[66] Williams and Woessner, *supra* note 61.

[67] But see Williams and Woessner, supra note 61, p. 9 (Reports that senior Russian Minister in the Russian Ministry of Internal Affairs told the US Congress in May 1994 that "criminal groups were becoming increasingly interested in nuclear energy facilities," and were involved in 47 criminal cases concerning "nuclear materials.")

[68] Quoted in Mark Hibbs, "Plutonium, Politics, and Panic," *The Bulletin of Atomic Scientists,* (November-December 1994): 31.

[69] For a detailed description of likely professional smuggling networks operating out of the FSU see Yossef Bodansky and Vaughn S. Forrest, "The New Nuclear Smuggling System," *Task Force on Terrorism and Unconventional Warfare, House Republican Research Committee, U.S. House of Representatives*, June 7, 1993. See also Andrew Borowiec, "Cash-rich Russians use Cyprus as base," *Washington Times*, 20 May 1995, p. A6 (Russian smugglers of arms and components for nuclear and chemical warfare use Cyprus as gateway to the Middle East).

[70] Roger C. Molander and Peter A. Wilson, "On Dealing with the Prospect of Nuclear Chaos," *The Washington Quarterly,* (Summer 1994): 19, 30.

[71] John Roberts, "Disarmament: "Nuclear Interpol" Needed to Combat Trafficking," *International Press Service [Online]*, February 16, 1995: Available NEXIS Library.

[72] *Ibid.*, 8.

[73] "U.S., Russian Intelligence Agencies Offer Proliferation Assessments," *Arms Control Today*, (March 1993), 21.

[74] *Ibid.*

[75] Chris Hedges, "Nuclear Trail--a Special Report: A Vast Smuggling Network Feeds Iran's Arms Program," *New York Times*, 15 March 95, p. A1.

[76] *Ibid.*

[77] See *supra* notes 45-59 and accompanying text on these efforts.

[78] Hanley, *supra* note 61.

[79] Commission of the European Communities, "The Illicit Traffic in Radioactive Substances and Nuclear Materials," *Communication from the Commission to the Council and the European Parliament* (Com(94) 383 final, Brussels, 7 September 1994); John Roberts, "Disarmament: 'Nuclear Interpol' needed to combat trafficking," *International Press Service*, February 16, 1995.

[80] Interviews by author of EURATOM officials in Brussels on 27 March 1995 and IAEA Officials on 21-22 March 1995; IAEA Board of Governors, "Measures Against Illicit Trafficking in Nuclear Materials and Other Radioactive Sources," *Progress Report by the Director General* (GOV/2773/Add.1), 6 March 1995; "Measures Against Illicit Trafficking in Nuclear Materials and other Radioactive Sources, *Report by the Director General* (GOV/2773), 24 November 1994..

[81] *Ibid.*

[82] Interviews with DOE officials, 13 March 1995. The Department of Energy has developed a comprehensive program to assist Russia and the Newly Independent States in controlling and physically protecting its nuclear materials, and developing a number of measures to prevent, delay or interrupt black-marketing activities. These proposed measures are contained in a for official use only document entitled *Nuclear Security: Countering Illicit Nuclear Material Transactions*, dated February 1995.

[83] Interviews by author of numerous DOD, ACDA, DOE officials, 13-16 March, 18-19 May.

[84] *Ibid.*

[85] The author has proposed this to the IAEA's Legal Division and other IAEA officials and received a positive response. EURATOM has also expressed interest in working on model legislation. Interview with Mr. Bram Brands, Directorate Energy Policy, Commission of the European Communities, 27 March 1995.

[86] Since HEU can be easily blended down into lower enriched uranium for use as nuclear reactor fuel the disposition problem with HEU is small, particularly in relation to plutonium, and for that reason is not addressed here.

[87] Matthew L. Wald and Michael R. Gordon, "Russia Treasures Plutonium, But U.S. Wants to Destroy It," *New York Times*, 19 August 1994, p. A1.

[88] The characteristics of nuclear reactors are explained in *Nuclear proliferation and Safeguards*, Appendix Vol. II, Part One, Washington D.C. Office of Technology Assessment, June 1977. Appendix V (Technical Description of Fuel Cycle Facilities and Evaluation of Diversion Potential).

[89] Paul Leventhal and Daniel Horner, "NPT Extension Should Not Ignore the Dangers of Plutonium," *Disarmament Times*, 22 November 1994, p.1.

[90] It takes about 77 pounds (35 kilograms) of unprocessed civil plutonium to make an explosive device. See "Uranium, Plutonium, Pandemonium," *The Economist*, 5 June 1993, p. 98.

[91] Pat Coyne, "Do We Need a Nuclear Interpol to Police the World's Growing Stocks of Plutonium?" *New Statesman & Society*, 23 April 1993, p. 25

[92] David Albright, Frans Berkhout and William Walker, *World Inventory of Plutonium and Highly Enriched Uranium*, (New York: Oxford University Press, 1993).

[93] See Brian G. Chow and Kenneth A. Solomon, *Limiting the Spread of Weapon-Usable Fissile Materials* (Santa Monica: Rand Corporation, 1993): 44-60.

[94] There is currently about 800 metric tons of civilian plutonium in spent fuel stored around the world, and the total is growing at about 70 metric tons per year. See John P. Holdren, "Dangerous Surplus," *Bulletin of Atomic Scientists* (May/June 1994): 39-40.

[95] Coyne, *supra* note 89.

[96] Great Britain stopped producing fissile materials for explosive purposes in April 1995 but it continues to produce plutonium "fuel) at its plutonium reprocessing plant at Sella field in Cumbria. See Barbara Crossette, "China Breaks Ranks With Other Nuclear Nations on Treaty," *New York Times*, 19 April 1995, p. A16.

[97] See "Management and Disposition of Excess Weapons Plutonium: Excerpts From the Executive Summary of the National Academy of Sciences Report," *Arms Control Today* (March 1994), 27. The Panel Chairman was Dr. Wolfgang K.H. Panofsky.

[98] *Ibid.*

[99] Bette Hileman, "Nuclear Arms Dismantling: NAS urges steps to safeguard plutonium," *Chemical & Engineering News*, 31 January 1994, p.6.

[100] Dr. Wolfgang K.H. Panofsky quoted in "Nuclear Arms Dismantling," *Ibid.*

[101] John P. Holdren, "Dangerous Surplus, *The Bulletin of Atomic Scientists* (May/June 1994): 39.

[102] It is not the intent in this paper to reiterate or evaluate all options and recommendations for the disposition of plutonium, but rather only to note the long term proliferation risks it poses, illuminate the lack of controls of this material in the former Soviet Union, recognize that solutions to this problem will not be easy technologically or inexpensive, and to highlight the need to address not only the weapons-grade plutonium issue but the potentially much more severe and global problem of reactor-grade plutonium. For a discussion of plutonium disposition options see National Science Academy's study entitled "Management and Disposition of Excess Weapons Plutonium," excerpts of which are reported in *Arms Control Today*, March 1994, pp. 27-31; Brian G. Chow and Kenneth A. Solomon, *supra* note 91; Frans Berkhout et al., "Disposition of Separated Plutonium," *Science & Global Security* (3-4, March 1993): 161-214; George Perkovich, "The Plutonium Genie," *Foreign Affairs* (Summer 1993): 153; Wolfgang K. H. Panofsky, "Safeguarding the Ingredients for Making Nuclear Weapons," *Issues in Science and Technology* (Spring 1994): 67; John P. Holdren, "Dangerous Surplus," *Bulletin of Atomic Scientists* (May/June 1994): 39; Paul Leventhal, "What Should Be The Fundamental Basis of a National Plutonium Policy?" *Nuclear Control Institute Paper*, March 8, 1994.

[103] For example, the National Academy of Sciences estimates it will cost from $1 to $5 billion for processing 50 tons of weapons-grade plutonium. U.S. Congress, *Hearings on National Defense Authorization Act for Fiscal Year 1995, Committee on Armed Services House of Representatives, HASC No. 103-39*, U.S. Government Printing Office, 1994, 567. Costs for storing weapons grade plutonium and ultimate disposition of plutonium-laced radioactive wastes vary but would not be much given the proliferation risks of not adequately safeguarding these materials. See Brian G. Chow and Kenneth A. Solomon, *supra* note 91 at 67-70.

[104] Frank von Hippel, Marvin Miller, Harold Feiveson, Anatoli Diakov and Frans Berkhout, "Eliminating Nuclear Warheads," *Scientific American* (August 1993): 44.

[105] See e.g. "Nuclear Dump Site Proposal Decried as Dangerous," *Providence Sunday Journal*, 5 March 1995, p. A11.

[106] *Hearings Before the Senate Foreign Relations Committee on IAEA Programs of Safeguards*, 9th Cong., 1st Sess. 43 (1981) (Statement of Victor Gilinsky).

[107] For an exhaustive study on the IAEA, to include its history and activities see Lawrence Scheinman, *The International Atomic Energy and World Nuclear Order* (Washington D.C.: Resources for the Future, 1987).

[108] The IAEA's role in the NPT evolved from Art. III of the NPT that states "Each non-nuclear-weapon State Party to the Treaty undertakes to accept the safeguards, as set forth in an agreement to be negotiated and concluded with the International Atomic Energy Agency and the Agency's safeguards system...."

[109] IAEA *Highlights of Activities* (IAEA Division of Public Information, September 1993), 45.

[110] *IAEA Safeguards Glossary 87 Edition*, (International Atomic Energy Agency, Vienna, 1987), 3.

[111] *Ibid.*, 23.

[112] See Thomas B. Cochran and Christopher E. Paine, "The Amount of Plutonium and Highly Enriched Uranium Needed for Pure Fission Nuclear Weapons," *Natural Resources Defense Council*, Washington, D.C. August 22, 1994; J. Carson Mark, "Some Remarks on Iraq's Possible Nuclear Weapon Capability in Light of Some of the Known Facts Concerning Nuclear Weapons," *Nuclear Control Institute*, May 16, 1991, p. 11 (Iraq could have built a nuclear weapon using about 12.3 kilograms of HEU); Steven Dolley and Paul Leventhal, *Nuclear Control Institute Backgrounder*, "Highly Enriched Uranium Seized in Czech Republic Reveals a Growing Risk of Nuclear Terrorism," December 22, 1994 (only 3 kilograms of HEU sufficient to produce nuclear bomb).

[113] The Natural Resources Defense Council has argued that the "significant quantities" standard should be lowered to 1 kilogram for plutonium and 3 kilograms for HEU since a 1-kiloton nuclear weapon can be made from these amounts. See "Tighter Nuclear Safeguards Needed to Stop Thefts," *Chemical and Engineering News*, September 12, 1994, p. 17.. However, given the degree of sophistication required to build so small a bomb, it is likely that much higher amounts would be used. Unsophisticated proliferators would use larger amounts of fissile materials than necessary in order to build simple, very high confidence weapons. Still, the NAS report, *supra* note 99, pointed out that 4 kilograms of plutonium was sufficient for a weapon.

[114] Robert Rudney, "A Toothless Watchdog: The International Atomic Energy Agency," *National Security Law Report*, (American Bar Association Standing Committee On Law and National Security, January 1995), 1.

[115] See e.g. Albert Wohlstetter, et al., *Moving Toward Life in a Nuclear Armed Crowd?* (ACDA/PAP-263, PH 76-04-389-14) (April 22, 1976).

[116] General Accounting Office, *Nuclear Fuel Reprocessing and the Problems of Safeguarding Against the Spread of Nuclear Weapons* iii-v, 30-34 (EMD-80-38, March 18, 1980); Paul Leventhal, "IAEA Safeguards Shortcomings--a Critique," *Nuclear Control Institute* (September 12, 1994); Frank Gaffney, Jr., "The IAEA's Dirty Little Secret, *The International Economy*, September/October 1994, p. 52; Marvin Miller, "Are IAEA Safeguards on Plutonium Bulk-Handling Facilities Effective?" *Nuclear Control Institute* (August, 1990).

[117] Paul Eavis, "The Case Against Reprocessing," Frank Barnaby, ed., *Plutonium and Security: The Military Aspects of the Plutonium Economy* (London: MacMillian Academic and Professional Ltd, 1992), 24.

[118] *Ibid.*

[119] *IAEA Safeguards Glossary*, International Atomic Energy Agency, Vienna, 1987, p. 3.

[120] Paul Leventhal, *supra* note 114 at 3. Richard Bolt, "Response to David Fischer on Safeguards Controversy," *Bulletin of Atomic Scientists* (June 1989), 39.

[121] Paul Leventhal, *supra* note 114.

[122] Paul Leventhal, "Latent and Blatant Proliferation: Does the NPT Work Against Either?" *Nuclear Control Institute*, June 20, 1990.

[123] Quoted by Marc Dean Millot, "Facing the Emerging Reality of Regional Nuclear Adversaries," *The Washington Quarterly* (Summer 1994): 53.

[124] Quoted by Patrick J. Garrity, *Why the Gulf War Still Matters: Foreign Perspectives on the War and the Future of International Security*, Report No. 16 (Center for National Security Studies, July 1993), p. xiv.

[125] It is not the intent of this paper to examine in detail all the motivations/reasons states may decide it is in their national security interests to pursue a nuclear weapons program. That has already been addressed exhaustively by a number of experts. See, for example, Mitchell Reiss, *Without the Bomb* (New York: Columbia University Press, 1988); Mitchell Reiss and Robert S. Litwak, eds. *Nuclear Proliferation After the Cold War* (Washington: Woodrow Wilson Center Press, 1994); Dean Wilkening and Kenneth Watman, *Nuclear Deterrence in a Regional Context* (Santa Monica: Rand Corporation 1995).

[126] Munir Ahmad Khan, "Toward a Universal Framework of Nuclear Restraint," in Joseph F. Pilat and Robert E. Pendley, eds. *Beyond 1995: The Future of the NPT Regime* (New York: Plenum Press, 1990), 89.

[127] Aabha Dixit, "West Grabs Victory in NPT," *Defense News*, 15-21 May 1995, p. 24.

[128] Sanjoy Hazarika, "India Denounces Extension of Treaty to Curb Atom Arms," *New York Times*, 16 May 1995, p. 8. On numerous occasion both at the UN First Committee (Arms Control and Non-Proliferation) and the Conference on Disarmament, the author has listened to public statements and talked with delegates from lesser developed countries who have railed against US "nuclear imperialism."

[129] Barbara Crossette, "U.S. Pushes Treaty to Ban Nuclear Tests," *New York Times*, 22 January 1996, p. 5.

[130] Some states might be considered "virtual" nuclear weapon state by the fact that they have the fissile materials, technology, and infrastructure to relatively quickly develop nuclear weapons. Japan and Germany are the two most obvious examples. Concerns over Japan's fissile material stockpile and reaction to a nuclear-armed North Korea in the face of a diminishing nuclear security umbrella from the US has heightened fears that Japan could "go nuclear." See Selig S. Harrison, "A Yen for the Bomb?" *Washington Post*, 31 October 1993, p. C1; Michael Williams, "Japan Urged to Keep Potential for Nuclear Arms," *Wall Street Journal*, 2 August 1994, p. 10.

[131] Joseph A. Yager, *Prospects for Nuclear Proliferation Rollback*, Discussion Paper, July 6, 1992, Department of Energy, Office of Arms Control and Nonproliferation.

[132] While there have been other cases of nuclear proliferation "roll back"; South Africa being the most recent example, the case of Argentina and Brazil present the best example of regional rivalry leading to both sides engaging in an arms race and nuclear weapons programs subsequently to be reversed by factors that may be relevant to other regions of proliferation concern. See Leonard Spector, *Nuclear Ambitions* (Boulder Co: Westview Press 1990); David Fischer, *Stopping the Spread of Nuclear Weapons: The Past and the prospects* (New York: Routledge 1992).

[133] John R. Redick, Julio C. Carasales, and Paulo S. Wrobel, "Nuclear Rapprochement: Argentina, Brazil, and the Nonproliferation Regime," *The Washington Quarterly* (Winter 1995): 107-122. Argentina, Brazil and ABACC also ratified an agreement with the IAEA (Known as the Quadripartitie Agreement), which entered into force on March 4, 1994, for the application of fullscope IAEA safeguards to all nuclear materials and equipment.

[134] These factors are taken from Redick, et.al., *supra.*

[135] See note 118.

[136] See note 120.

[137] David Albright and Tom Zamore, "India, Pakistan's Nuclear Weapons: All the Pieces in Place," *Bulletin of Atomic Scientists* (June 1989): 24.

[138] David Albright and Mark Hibbs, "Pakistan's Bomb: Out of the Closet," *Bulletin of the Atomic Scientists*, (July/August 1992), 38. See also Gregory Giles, "Safeguarding the Undeclared Nuclear Arsenals," *The Washington Quarterly* (Spring 1993): 175.

[139] See Summit Ganguly, "South Asia After the Cold War," *The Washington Quarterly* (Autumn 1992): 174.

[140] David Fischer, *supra* note 138 at 205. According to unclassified estimates, India may have accumulated over 300 kilograms of weapons-usable fissile materials. See David Albright, Frans Berkhout, and William Walker, *World Inventory of Plutonium and Highly Enriched Uranium, 1992*, (New York: Oxford University Press 1993): 161.

[141] Albright and Hibbs, *supra* note 144 at 38-43.

[142] Albright and Hibbs, *supra* note 144 at 38; Yossef Bodansky, "Nuclear Weapons and Radical States Pose New Situations," *Defense & Foreign Affairs' Strategic Policy* (June 1992): 18.

[143] Albright and Hibbs, *supra* note 144 at 42.

[144] See e.g. Shirley A. Kan, "Chinese Missile and Nuclear Proliferation: Issues for Congress," *Congressional Research Service Report* (7 December 1992).

[145] Giles, *supra* note 144 at 178.

[146] Spector, *supra* note 138 at 110.

[147] Indeed, one Pakistani official admitted to the author that Pakistan had been approached by "several unnamed" states with offers for financial assistance in return for a "cooperative" arrangement vis-à-vis nuclear weapons programs. Interview with the author, March 23, 1995.

[148] US offers of economic incentives to Pakistan are subject to two preconditions: (1) stopping production of HEU and weapons cores; and (2) destroying the cores already produced. This has been rejected by Pakistan unless India does the same. See Jeffrey Smith "Pakistan Official Affirms Capacity for Nuclear Device," *Washington Post*, 7 February 1992, p. A18.

[149] See *infra* notes 175-193 and accompanying text regarding possibilities for a "cut-of" treaty.

[150] William J. Clinton, "Address to the 48th Session of the UN General Assembly," *White House Office of the Press Secretary*, 27 September 1993.

[151] As of 14 April 1995 there are 178 states parties to the NPT. See Arms Control and Disarmament Fact Sheet, "Signatories and Parties to the Treaty on the Nonproliferation of Nuclear Weapons," (US ACDA Office of Public Affairs: Washington D.C.).

[152] Barbara Crossette, "U.S. Ready to Seek Worldwide Ban on Nuclear Arms Tests," *New York Times*, 15 May 1995, p. 7. The extension decision is reported in UN Document "Extension of the Treaty on the Non-Proliferation of Nuclear Weapons," (NPT/Conf.1995/L.6, 9 May 1995).

[153] See Article II, Treaty on the Non-Proliferation of Nuclear Weapons. Other perceived deficiencies are that the treaty does not have any compliance or sanctions provisions, it does not preclude nuclear trade with non-NPT members, and it does not prohibit a NNWS from assisting another NNWS in acquiring fissile materials for a weapons program.

[154] Quoted in Stephen S. Rosenfeld, "How the Nuclear Haves Can Discourage Proliferation," *International Herald Tribune*, 27 March 1995, p. 8.

[155] *Joint Statement of Presidents Clinton and Yeltsin on Nonproliferation*, 10 May 1995. See also *the Joint Statement on the Transparency and Irreversibility of the Process of reducing Nuclear Weapons*, 10 May 1995 (fissile materials removed from nuclear weapons will not be used to manufacture new nuclear weapons, no new fissile materials for nuclear weapons will be produced and no fissile materials from civilian programs will be used in nuclear weapons).

[156] Interviews conducted by author of IAEA officials and Conference on Disarmament delegates, 20-25 March 1995.

[157] For a description of the IAEA's responsibilities see *supra* notes 105-120 and accompanying text.

[158] The loudest voices have often been those increasingly feeling isolated by not being part of the regime. For example, despite overwhelming approval by the states parties for indefinite extension, India continued to denounce the treaty as "perpetuating nuclear discrimination." See Sanjoy Hazarika, "India Denounces Extension of Treaty to Curb Atom Arms," *New York Times*, 16 May 1995, p. 8.

[159] Agreement Between the United States of America and the International Atomic Energy Agency for the Application of Safeguards in the United States (and Protocol Thereto), 32 U.S.T. 3059, T.I.A.S. 9889. Signed November 18, 1977; entered into force December 9, 1980 (Provides for the application of IAEA safeguards to all peaceful nuclear activities in designated nuclear facilities in the United States). See also Agreement Between the United States and the International Atomic Energy Agency for the Application of Safeguards in

Connection with the Treaty for the Prohibition of Nuclear Weapons in Latin America (US accepts full-scope safeguards for its territories in the Latin American Nuclear Weapons Free Zone); signed February 17, 1989; entered into force April 6, 1989; reported in Department of State, *Treaties in Force, 1 January 1992*, (Washington, D.C.: Government Printing Office, 1993).

[160] See Atomic Energy Act, as amended, 42 U.S.C. § 2131-41 (licensing procedures), 2271-2284 (enforcement).

[161] Interviews of Conference on Disarmament delegates, 24-25 March 1995.

[162] *Highlights of Activities*, International Atomic Energy Agency (IAEA Division of Public Information, September 1993), 54. Out of the almost $245 million budget for 1992, the IAEA spent approximately $70 million on safeguards activities.

[163] *Ibid.*, 62; Arms Control and Disarmament Fact Sheet, *The US Commitment to the Nuclear Non-Proliferation Treaty, 1995*, (Washington D.C.: US ACDA Office of Public Affairs), 15.

[164] *Ibid.*, 13-18.

[165] See e.g. the US Atomic Energy Act, as Amended by the Nuclear Non-Proliferation Act of 1978, 42 U.S.C. § 2100 et. seq.

[166] Lally Weymouth, "Riches to Rogues," *Washington Post*, 20 April 1995, p. A21.

[167] See *infra* notes 194-203 and accompanying text for a discussion of this proposal.

[168] "Remarks of Defense Secretary Les Aspin to the National Academy of Sciences Committee on International Security and Arms Control," *Federal News Service [Online]*, December 7, 1993: Available in LEXIS/NEXIS Library.

[169] See Wilkening and Watman, *supra* note 123.

[170] Interview with the author, March 21-22, 1995.

[171] Jon B. Wolfsthal, "IAEA to Implement 'Suspect Site' Inspection Powers," *Arms Control Today*, (March 1992): 27. Although the IAEA Statute already authorizes such inspections (Art. XII A.6), the IAEA had never undertaken a special inspection. The Board action served to validate the IAEA's powers and this authority was soon to be sorely tested by North Korea.

[172] "Strengthening the Effectiveness and Improving the Efficiency of the Safeguards Systems," *A Report by the Director General*, IAEA Board of Governors, GOV/INF/759, 23 November 1994 and GOV/2784, 21 February 1995. These reports are detailed, comprehensive, and technical. The focus is on effectiveness and cost efficiency.

[173] *Strengthening the Effectiveness and Improving the Efficiency of the Safeguards System: Proposals for a Strengthened and More Efficient Safeguards System, A Report by the Secretary General*, IAEA Board of Governors' Document, Gov/2807, 12 May 1995 (The Board of Governors noted the Director General's plan to implement the less controversial provisions of "93+2" and deferred action on proposals for increased access amid complaints that intrusive inspections would unduly interfere "in a states' economic and safe use of peaceful nuclear activities." As of December 1995 the Board has still not acted on the proposals.

[174] Interview with IAEA Official, 21 March 1995.

[175] Rudney, *supra* note 112.

[176] David A. Kay, "Denial and Deception Practices of WMD Proliferators: Iraq and Beyond, *The Washington Quarterly* (Winter 1995): 85.

[177] UN General Assembly, 48th Session, Resolution 48/75L, adopted without a vote in December 1993.

[178] A naturally occurring, colorless, radioactive gaseous isotope of hydrogen used to enhance the effects of thermonuclear weapons. It is produced commercially from Lithium-6 by slow neutron bombardment in nuclear reactors. It also poses a radiation hazard from inhalation as particles in the lungs may be a long-term carcinogenic hazard.

[179] *Ibid.* The delay in closing the Russian reactors is due to the fact that some are dual-use; that is, they supply power to the local communities in addition to making plutonium. It will take time and financial resources the Russians do not have to develop alternative sources of energy.

[180] Statement by Russian Ambassador to the Conference on Disarmament, Grigori Berdennikov, "Setting the Context for the Cut-off Treaty," to the Canadian Workshop on Fissile Materials, January 17, 1995.

[181] Barbara Crossette, "China Breaks Ranks With Other Nuclear Nations on Treaty," *New York Times,* 19 April 1995, p. A16. The statement did not say, however, that the UK had permanently ceased production.

[182] Therese Delpech, "A Convention on the Prohibition of the Production of Fissile Material: Uncertain Benefits for Non-Proliferation," Research Paper No. 31, *Halting the Production of Fissile Materials for Nuclear Weapons*, United Nations Institute for Disarmament Research, 1994.

[183] The Conference on Disarmament has 35 member states and meets in almost continuous sessions to negotiate multilateral arms control agreements. This is the forum that is currently negotiating the Comprehensive Test Ban Treaty, and successfully concluded in 1992 negotiations on the Chemical Weapons Convention. In addition to these negotiations, it also has committees on negative security assurances and radiological weapons (non-nuclear explosive devices containing radioactive materials).

[184] Vilmos Cserveny, "An IAEA Secretariat Working Paper on Different Alternatives for the Verification of a fissile Material Production Cut-off Treaty and Preliminary Cost Estimates Required for the Verification of these Alternatives," Paper presented at the Canadian Workshop on a Cut-Off Treaty, Toronto, Canada, 17-18 January 1995.

[185] Interview of IAEA Deputy Director, Department of Safeguards, March 21, 1995.

[186] The German ambassador to the Conference on Disarmament has proposed putting all fissile material, civilian as well as military, under safeguards, and including undeclared stocks of the threshold states in the cut-off negotiations. Ambassador Wolfgang Hoffman, "Basic Obligations and Scope of the Cut-Off Convention," Paper presented at the Canadian Workshop on Fissile Material Production Cut-Off, Toronto, January 17-18, 1995. Canadian officials have also raised concerns about any cut-off regime that would legitimize existing stockpiles in threshold states. Delpech, *supra* note 165.

[187] Interview First Secretary of Pakistani delegation to the Conference on Disarmament, March 24, 1995.

[188] Interview Indian delegate to the Conference on Disarmament, March 24, 1995.

[189] Given the priority of negotiating a CTBT in the Conference of Disarmament before April 1996 it is unlikely that there will be any meetings on substance until the Fall 1o 1996 at the earliest.

[190] Interview Pakistani delegate to the Conference on Disarmament, March 24, 1995.

[191] Although Israel is not yet a member of the Conference on Disarmament it has applied for membership and has observer status. When the author interviewed Israeli representatives on this matter in March 1995, the response was that the Israeli Government was still formulating its position and they were unwilling to speculate on the outcome.

[192] *White House Fact Sheet On Non-Proliferation and Export Control Policy*, Office of the Press Secretary, September 27, 1993.

[193] *White House Fact Sheet on Excess Fissile Material*, Office of the Press Secretary, March 3, 1995; Douglas Jehl, "Clinton Pledges to Reduce U.S. Nuclear Stockpiles by 200 tons," *New York Times, 2* March 1995, p. A6. Approximately 50 tons of HEU will be transferred to the US Enrichment Corporation, and some of the rest of the material will be considered for IAEA safeguards taking into account the need to protect sensitive information and other requirements.

[194] *Ibid*. The exact amount of material in the current US stockpile remains classified.

[195] Presidents Clinton and Yeltsin, *Joint Statement on the Transparency and Irreversibility of the Process of Reducing Weapons*, 10 May 1995.

[196] Jon Brook Wolfsthal, "Nuclear-Weapon-Free Zones: Coming of Age? *Arms Control Today* (March 1993): 3 (Explains and details criteria which the US has traditionally used to judge acceptance of proposed NWFZs).

[197] 22 U.S.T. 762; TIAS 7137; 634 UN Treaty Series 281; entered into force April 22, 1969. The treaty is often referred as the Treaty of Tlatelolco.

[198] Additional Protocol I; 33 U.S.T. 1792; TIAS 10147; 634 UN Treaty Series 362; ratified on November 19, 1981.

[199] Additional Protocol II; 22 U.S.T. 754; TIAS 7137; 634 UN Treaty Series 364; ratified on May 8, 1971. See the discussion, *infra* notes 198-99 for an explanation of negative security assurances.

[200] 24 International Legal Materials 1440 (1986) (entered into force 11 December 1985). Protocols 2 and 3 were ratified by China and the U.S.S.R. in 1988.

[201] Two other treaties prohibit nuclear weapons within their zone of application: The Antarctic Treaty and the Seabed Arms Control Treaty. The Antarctic Treaty, banning nuclear weapons on the Antarctic Continent, entered into force on June 23, 1961; 12 U.S.T. 794; TIAS 4780; 402 UN Treaty Series 71. The Seabed Arms Control Treaty, banning nuclear weapons on or under the seabed and the ocean floor, entered into force May 18, 1972; 23 U.S.T. 701; TIAS 7337; 955 UN Treaty Series 115.

[202] See e.g. U.N. General Assembly Resolution 3472 B (XXX) [30th Session] of December 11, 1975.

[203] See e.g. "Voting Chart of Conference on Disarmament members on Disarmament Resolutions," *Disarmament Times*, 20 December 1994, pp. 2-3. The US, however, has resisted ratifying the Treaty of

Rarotonga's protocols applicable to it principally because of its unwillingness to damage relations with France over its nuclear tests in the zone.[203] In view of France's apparent willingness to negotiate a comprehensive test ban and its statement in January 1993 that it will not test until the US or Russia resumes testing, the United States should reconsider its position. Given the attenuated security concerns in the region, the end of the Cold War confrontation and the immediate proliferation concerns the US would send a strong signal of commitment to regional nonproliferation and perhaps provide the impetus to advancing its non-proliferation goals in other regions.

[204] White House press Release, May 29, 1991. For a recent analysis of prospects for a NWFZ in the Middle East, see UN General Assembly, 45th Session, *Establishment of a Nuclear Weapons-Free Zone in the Region of the Middle East*, 10 October 1990.

[205] That agreement, in addition to banning nuclear weapons, prohibits either side from possessing uranium enrichment and plutonium reprocessing facilities. See Joint Declaration of South and North Korea on the Denuclearization of the Korean Peninsula; signed at Seoul and Pyongyang on 20 January 1992, entered into force on 19 February 1992; reprinted in Harald Muller, David Fischer and Wolfgang Kotter, *Nuclear Non-Proliferation and Global Order* (New York: Oxford University Press 1994): 236.

[206] William J. Clinton, "Address to the 48th Session of the UN General Assembly," White House Office of the Press Secretary, September 27, 1993, p. 6.

[207] "In the ninth century the King of France imposed the death sentence on anyone who sold a sword to a Viking. This did not prevent the Vikings from taking Normandy or, even worse, their children from conquering England." David Fischer, "The London Club and the Zangger Committee: How Effective?" in Kathleen Bailey and Robert Rudney (eds.), *Proliferation and Export Controls* (Lanham, MD: University Press of America, 1993): 39.

[208] For a detailed explanation of the Nuclear Suppliers Group see Tadeusz Strulak, "The Nuclear Suppliers Group," *Non-Proliferation Review* (Monterey Institute of International Studies, Fall 1993): 1.

[209] See Theresa Hitchens and Brooks Tigner, "Arms Control Formum May Lack CoCom's Punch," *Defense News*, December 18-24, 1995, p. 4. The scope of this paper is necessarily limited to the problem of controlling the spread of nuclear weapons-grade materials. While export controls traditionally included such materials the primary focus has been on dual-use technology, equipment, services and information. For proposals and recommendations for enhancing controls in this area see "Beyond COCOM: A Comparative Study of Export Controls: Germany, United Kingdom, France, Italy and Japan and the European Union Export Control Regulation," *Task Force on Nonproliferation of Weapons of Mass Destruction of the American Bar Association Standing Committee on Law and National Security* (September 1994).

[210] Established in 1975 (after the Indian nuclear test), the NSG is the outcome of an informal agreement to restrict the trade in nuclear materials and technology.

[211] See IAEA Document INFCIRC/254/Rev.1/Part 2, July 1992. A partial copy of this document is reprinted in Muller, Fischer and Kotter, *supra* note 203 at 236.

[212] See IAEA Document INFCIR/254/Rev.1/ Part 1, July 1992, and INFCIRC/254/Rev. 1/Part 1/Mod. 1, July 1993. The NSG guidelines are reproduced in Muller, Fischer and Kotter, *supra* note 188 at 238 and in Joseph Goldblat, *Twenty Years of the Non-Proliferation Treaty: Implementation and Prospects*, (Oslo: Peace Research Institute Oslo, 1990): 123-131.

[213] The author is indebted to Mr. Burrus Carnahan of the Science Applications International Corporation for this proposal.

[214] Harald Muller, "Europe's Leaky Borders," *Bulletin of Atomic Scientists* (June 1993): 27.

[215] "Studies Fault U.S. Controls Over 'Dual-Use' exports," *Arms Control Today* (July/August 1994): 21.

[216] Burrus M. Carnahan and Jacqueline R. Smith, "A Treaty to Ban Nuclear Smuggling: the Next Step in Nuclear Material Control?" *Arms Control Today,* (October 1994): 14-17.

[217] See e.g. Convention for the Suppression of Unlawful Seizure of Aircraft (Hijacking), 22 U.S.T. 1641; TIAS 7192; entered into force October 14, 1971.

[218] Quoted in Ralph E. Lapp, "The Einstein Letter that Started it all," *New York Times Magazine*, 2 August 1964, p. 13.

[219] As noted at the beginning of this paper, the enforcement of non-proliferation norms and US counterproliferation efforts is not addressed, although its importance and utility as part of non-proliferation strategies is recognized and accepted.

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